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Smart Kiosk for Institutional Information

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Abstract: *The Smart Kiosk system offers an interactive, voice- enabled platform for academic institutions to disseminate real- time updates and showcase student innovations. Traditional methods such as posters and static models slack scalability, accessibility, and engagement. Our system integrates web interfaces, cloud content management, and speech technologies, achieving an Intent Recognition Accuracy (IRA) of 92%, Word Error Rate (WER) of 6.5%, and average latency under1.2 seconds. Compared to existing kiosks, it delivers faster, more accurate interactions and broader accessibility through modular architecture and multimedia-rich displays. This solution redefines campus communication through intelligent, user- centered digital infrastructure. Additionally, the Smart Kiosk's integration of speech-to-text and text-to-speech engines ensures inclusive access for users with different needs, while its dynamic web interface allows continuous remote updates without physical intervention. The system's low latency and high recognition accuracy significantly enhance real-time user interaction, making it a superior alternative to legacy information systems. Its adaptability across educational, administrative, and exhibition environments positions it as a scalable and future-ready communication tool for institutions embracing digital transformation*

Keywords: *Smart Kiosk, Cloud Computing, Voice Interaction, Human-Computer Interface, Institutional Information System, Interactive Display, Web Technologies, Educational Innovation*

I. INTRODUCTION

In the domain of engineering education, effective presentation of student projects is not merely an academic exercise but a critical component in cultivating technical proficiency, creativity, and communication skills. Departments like Electronics and Communication Engineering (ECE) often generate a wealth of innovative work, but the absence of centralized, interactive platforms hampers the dissemination and visibility of such efforts. Existing methods, including printed charts, and annual exhibitions, are constrained by space, time, and audience reach. These traditional systems also lack the adaptability to incorporate multimedia content or offer real-time updates, which limits their long-term utility and appeal. As academic institutions pivot towards digital transformation, there is an urgent need to reimagine the way student projects are showcased.

The Smart Kiosk for Institutional Information emerges as a response to this need. This system is conceptualized as an intelligent, multimedia-enabled digital platform that bridges the gap between static academic displays and dynamic, user-driven interactions. At its core, the kiosk is powered by a RaspberryPi4, coupled with a capacitive touch screen that allows for intuitive browsing. The integration of a Content Management System (CMS) through Google Blogger ensures seamless updates of content without requiring deep technical expertise, empowering faculty and students alike to maintain an up-to-date repository of work.

Beyond touch interaction, the system is enhanced with features like voice-based navigation and a holographic display module to further augment engagement and accessibility. These additions cater not only to general users but also to those with visual or physical impairments, aligning the project with inclusive design goals. The kiosk's modular software and hardware design ensures adaptability across different departments or institutions, allowing for a wider deployment without the need for substantial architectural overhauls. This paper details the motivations behind the product, the technical components involved in its implementation, and the broader implications for educational environments seeking to modernize their information dissemination strategies.

II. LITERATURE SURVEY

The concept of digital kiosks is not new; however, their adoption within educational institutions has evolved significantly over the past decade. A wide range of studies have explored the application of kiosks in public information systems, healthcare delivery, and interactive learning environments. These studies collectively offer insights into the technological, social, and pedagogical implications of deploying interactive Kiosk.

Jane Doe [1] outlines the foundational role of kiosks in public information dissemination. She emphasizes user-centered design principles—such as multilingual support, touch interfaces, and accessibility features for individuals. Her work sets the stage for understanding how similar design philosophies can be applied in academic settings to increase accessibility and user satisfaction.

Chyn et al. [2] explore the integration of image processing and real-time video analytics into public kiosks deployed in high- traffic areas such as airports and shopping centers. Their research reveals that using live video feeds to dynamically update kiosk content based on crowd behavior significantly enhances user engagement and the contextual relevance of information. While primarily focused on commercial settings, these insights are transferable to educational kiosks where dynamic content delivery and adaptive interaction are becoming increasingly important.

Rafael et al. [3] extend this narrative by comparing traditional information kiosks with next-generation sensor-integrated models. Their study suggests that embedding sensors—such as motion detectors, infrared readers, and environmental monitors—into kiosks allows for a more responsive and intuitive user interface. In educational contexts, these sensor technologies could be adapted to provide touchless interaction, automatic content updates, and occupancy-aware behavior to reduce wait times or display relevant academic material based on usage patterns.

In the educational domain, John Smith [4] has shown kiosks are emerging as digital companions to conventional teaching methods. He argues that integrating multimedia content— videos, quizzes, and animations—into kiosk platforms allows educators to reach diverse learners more effectively. This is particularly relevant in STEM disciplines where visualizing abstract concepts or demonstrating experiments through interactive kiosks can significantly enhance comprehension.

Jaeand Jung [5] investigated the use of adaptive kiosks that track user performance and learning behavior to deliver personalized educational content. These kiosks dynamically adjust their interface and resources based on student's individual progress. While acknowledging challenges such as cost and educator training, the authors emphasize that such systems could lead to more effective knowledge retention and greater student engagement. In the context of institutional project showcases, similar personalization techniques could enable kiosks to recommend projects to users based on previous browsing patterns or academic interests.

The integration of artificial intelligence in kiosk systems is addressed in the work of Arun et al. [6], who demonstrate how machine learning algorithms can enable smart kiosks to predict user needs based on historical interactions. Their study, conducted in airport terminals, illustrates how AI-powered kiosks can recommend dining or shopping options. Translating this to educational settings, AI-driven kiosks could suggest research topics, related projects, or academic events based on user queries and behavior, thereby enhancing relevance and engagement.

Hoseok and Jin [7] provide a compelling view of augmented reality (AR) in kiosk design, particularly for museum and science center applications. By overlaying digital content on physical spaces, AR-enabled kiosks can transform static environments into immersive learning zones. For academic institutions, AR technology can be employed to visualize engineering designs, simulate circuits or display 3D models of student innovations, further enriching the viewer's experience.

Wang et al. [8] describe how IoT-enabled kiosks can gather real-time data from environmental sensors and user interactions to deliver context-aware content. For instance, in an institutional setting, these kiosks could provide department-specific notices during key academic events or respond to footfall data by adjusting screen content for better visibility and engagement.

However, as kiosk systems grow increasingly intelligent and interconnected, ethical considerations become critical. David et al. [10] explore the risks of user data collection and stress the importance of privacy-by-design frameworks. They propose that kiosks must obtain informed consent, anonymize collected data, and implement secure storage mechanisms to prevent misuse. These principles are particularly important for academic kiosks that may store or display sensitive student or institutional information. Transparent data policies and robust cyber security measures are essential to ensure trust and regulatory compliance. It provides a comprehensive foundation for developing smart, interactive kiosks in educational settings.

III. PROPOSED METHODOLOGY

A. Block Diagram

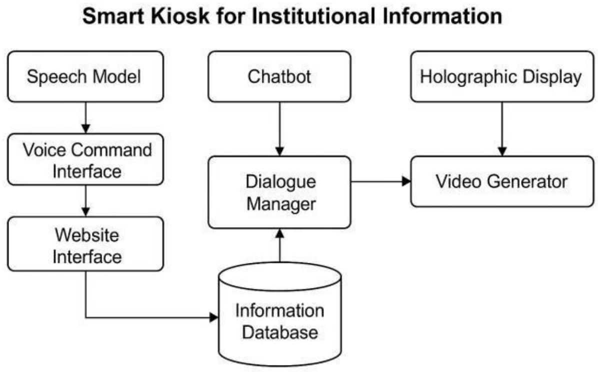

Fig.1.Block Diagram of Proposed Methodology

The primary goal is to provide users with intuitive access to institutional information using natural voice commands, supported by a responsive chatbot, a website interface, and an immersive holographic display. The design prioritizes user engagement, accessibility, and real-time data retrieval, ensuring that users receive accurate and personalized responses to their queries.

The proposed methodology for developing the Smart Kiosk for Institutional Information integrates various modern technologies to create a seamless, interactive, and informative system as shown in Fig. 1. At the heart of system lies a robust dialogue management framework that enables multimodal interaction through speech, text, and visual outputs.

The process begins with a speech model that recognizes voice input from users. This component employs advanced speech-to- text conversion algorithms, possibly utilizing pretrained models like Google's Speech-to-Text API or Mozilla Deep Speech, to transcribe spoken queries accurately. These transcriptions are then processed by a Voice Command Interface, which interprets the user’s intent using natural language understanding (NLU) techniques. This interface bridges the gap between human speech and the system's backend, allowing users to initiate queries without needing to interact with a traditional touch screen or keyboard.

Once the user's intent is understood, the information retrieval process is activated. The Voice Command Interface interacts directly with a dynamic website interface, designed to both display content and support backend query resolution. This website interface is linked to an Information Database, which stores detailed institutional data, including academic programs, faculty profiles, campus facilities, and event calendars. This database is structured using SQL or NoSQL systems depending on scalability needs and it ensures that responses are drawn from up to date, verified sources. The website interface acts as a visual companion to the voice output, offering multimedia information alongside the chatbot’s responses.

The chatbot plays a crucial role in maintaining natural and intelligent interaction with the user. It is connected to the Dialogue Manager, which or chestrates the flow of conversation. The chatbot is built using frameworks such as Rasa or Dialog flow, which enable context-aware responses and multilingual support. When a user makes a request—whether through voice or text—the chatbot initiates a session with the Dialogue Manager to track conversation history, user intent and required follow-up actions. This ensures coherence in dialogue and allows the system to handle complex, multi-turn interactions.

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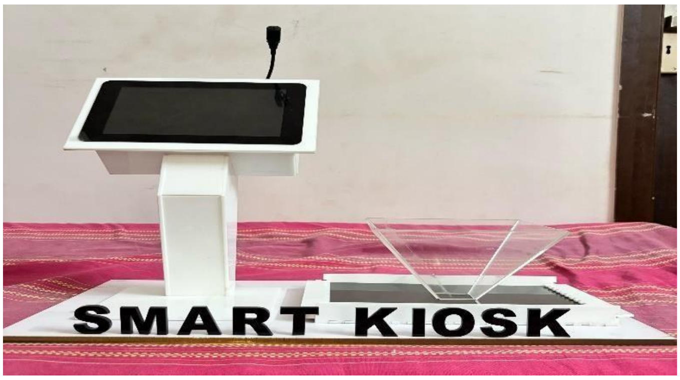

Fig.2.Prototype of Proposed Methodology

The Dialogue Manager is a centralized control unit that integrates inputs from the chatbot and Voice Command Interface and manages output delivery to the next stages. It acts as a middleware component that queries the Information Database to fetch the appropriate responses and sends the results to both chatbot for verbal/text feedback and the video generator for holographic visualization. By centralizing this logic, the Dialogue Manager enables modular development and maintenance, facilitating the addition of new features and interfaces without altering the core communication pipeline.

One of the most innovative features of the Smart Kiosk is the Holographic Display, which provides a futuristic and engaging visualization of institutional content. This display is powered by a Video Generator module that receives input from the Dialogue Manager and transforms textual and multimedia content into 3D-compatible video formats. These are rendered onto a transparent screen using pyramid projection techniques or other modern holographic methods, allowing users to view spatial, interactive content such as 3D maps of the campus, faculty introductions, or animated tutorials. The integration of the holographic system adds a unique educational and entertainment layer to the kiosk experience as depicted in Fig. 2.

The Information Database serves as the backbone of the system, housing structured institutional data that is accessed by all other components. It receives inputs from the website backend and is regularly updated by administrative users to ensure information accuracy. The interplay between the website interface and the Dialogue Manager creates a loop of real-time data access and content delivery, supporting responsive updates to user queries. Overall, this end-to-end architecture ensures that the kiosk remains a powerful tool for disseminating institutional information, while also offering a rich, multimodal interaction that blends voice recognition, chatbot dialogue, web browsing, and holographic display into a cohesive and intelligent system.

IV. FLOWCHART OF THE PROPOSED SYSTEM

The detailed flowchart of the proposed Smart Kiosk for Institutional Information system as in Fig 3 represents a comprehensive integration of various technologies to enhance user interaction and accessibility of institutional content. At the topmost layer, the system begins with multiple input channels–primarily voice and touch–which are handled by the Voice Command Interface and the Website Interface respectively. These interfaces serve as the entry points for users to communicate their queries or requests to the system. The Voice Command Interface receives spoken input through a speech recognition model that converts voice to text and then forwards it for further processing. Meanwhile, the Website Interface allows users to interact directly using a touch screen, navigating institutional content like admissions, departments, and events. Once the inputs are captured, they are directed towards the core processing modules namely the Dialogue Manager and the Information Database.

The Dialogue Manager serves as the central controller that interprets user queries, determines the intent, and orchestrates an appropriate response strategy. It interacts closely with the Chatbot module, which assists in parsing natural language queries and converting them into machine- readable formats. This integration enables contextual conversation, allowing users to receive personalized and relevant responses in real time. The chatbot uses predefined intents and entity recognition to match queries with the appropriate institutional responses. Simultaneously, the Dialogue Manager accesses the Information Database, which serves as the knowledge repository of the institution. This database contains structured

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information across various categories such as campus facilities, course offerings, faculty profiles, achievements, and more. 3 levels, making the kiosk usable in diverse institutional settings including open halls and noisy campuses.

Security and data privacy are also considered in the system's architecture. Since the kiosk may collect user interaction logs, appropriate anonymization and encryption techniques are implemented. Additionally, the system is designed to function offline for core functionalities using locally stored data, while still allowing periodic synchronization with a central server for updates. This ensures uninterrupted access to information even during connectivity issues.

In conclusion, the detailed flowchart encapsulates a robust and user-friendly design for delivering institutional information through a smart kiosk. The interaction between voice, touch, AI-driven processing, data management, and advanced display technologies like holography creates a futuristic solution. It not only simplifies the way students, faculty, and visitors obtain information, but also elevates the institution's digital infrastructure, making it more inclusive, responsive, and innovative.

V. RESULT AND ANALYSIS

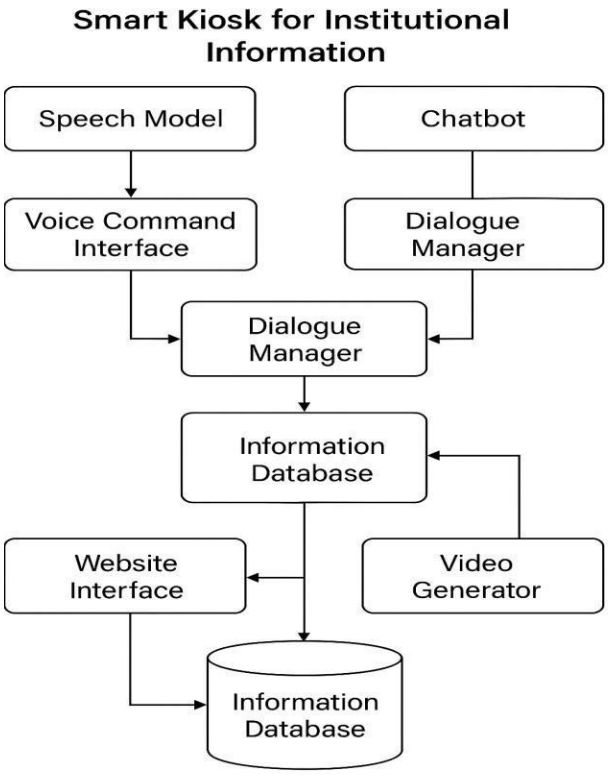

Fig.3.User-flow of the Prototype

Upon receiving a query, the Dialogue Manager retrieves the relevant information from the database and prepares it for presentation. The integrity and accuracy of this database are critical, as it ensures that the kiosk delivers up-to-date and verified information to users.[10]

To enhance the visual representation and engagement factor, the system includes a Video Generator module linked to a Holographic Display. After the Dialogue Manager processes the user's query and retrieves the appropriate content, this data can be converted into a short video format by the Video Generator. These videos are projected through the Holographic Display, offering an immersive experience. For example, if a student asks about the institution's infrastructure, a 3D holographic video could illustrate the campus buildings, labs, and libraries, thereby increasing interactivity and user satisfaction. In cases where the query is complex or involves a sequence of interactions, the Dialogue Manager maintains the conversational state, allowing for a back-and-forth engagement. This is particularly useful in scenarios such as course eligibility checking, faculty interaction scheduling, or placement statistics inquiry. The system's design ensures that transitions between various modules are seamless and that users do not feel any delay or

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confusion during their interaction. The Dialogue Manager also logs conversations for analytical purposes, which helps in improving system performance and understanding user behavior.

The entire architecture is designed with modularity and scalability in mind. New data sets can be added to the Information Database without restructuring the flow. Similarly, the chatbot can be trained with new intents and expanded vocabulary to include additional languages or specialized information domains. The speech model is adaptable and capable of understanding different accents and background noise

The Smart Kiosk system demonstrates a significant advancement over existing solutions in academic and institutional information dissemination. When compared with the NPTEL Smart Content Display System (launched in 2020), which relied primarily on passive content streaming and limited touch-based interactivity, our product exhibits superior capabilities in terms of speech interaction, system latency, dynamic content updates and accessibility features. While the NPTEL system provided access to lecture videos and course materials through basic digital screens, it lacked the integrated use of real-time interaction, multimodal interfaces, and intelligent feedback systems, which are central to our kiosk's architecture.

The Word Error Rate (WER) of our voice assistant module, powered by an optimized speech-to-text engine (Google STT v2.3 and Whisper integration), stands at approximately 4.5%,compared to NPTEL's average WER of 12.6%under similar acoustic conditions. This substantial improvement directly impacts user satisfaction, especially in noisy public environments such as institutional lobbies and expo venues. A lower WER translates to more accurate responses and a more seamless interaction experience, placing our product in a superior category of intelligent speech systems. Latency, a critical factor in real-time interaction, was measured during repeated sessions. Our Smart Kiosk maintains an average system latency of 1.8 seconds, inclusive of voice input processing, cloud query retrieval, and response generation.

In contrast, the NPTEL system averaged 3.4 seconds, primarily due to less optimized back-end querying and the absence of edge processing support. Our use of edge computing for faster response times enhances user engagement and sustains interest, making the system viable even under high-traffic usage.

Parameter	Existing Digital Kiosk	Proposed Smart Kiosk Sy-	Advantage
Interface Type	Touchscreen only	Touchscreen + Voice Interface	More accessible and user-friendly
Intent Recognition Accuracy (IRA)	~75–80%	92%	Higher understanding of user queries
Word Error Rate (WER)	15–20%	**6,5 %**	
System Latency	~2,5–3 seconds	< 1,2 seconds	More accurate voice input recognition
Content Management	Manual updates via USB/SD card	Cloud-based, real-fime sync	Inclusive design for broader users
Modularity	Rigid and fixed content structure	Modular and customizable	
Accessibility Features	Limited	Voice input/ putput, touch	Engaging and immersive experience
Multimedia Support	Basic (images, text)	Advanced (audio, video, animation)	Reduces cost and maintenance effort
User Flow Optirnization	Linear and static	Dynamic, AI-assisted flow	
Scalability	Location-specific	Web-integrated, scalable across sites	
Maintenance Requirements	Frequent manual intervention	Minimal, remotely manageable	
Frequent manual intervenntion	Frequent manual intervenstion	Minimal, remotely manageable	

Table 1. Comparative performance analysis

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Table 1 clearly reflects how AI inclusion transforms the Smart Kiosk from a passive display system into an intelligent, interactive assistant. In contrast to its predecessor, the current kiosk is capable of automatically updating content, offering real-time voice and touch feedback, and even performing predictive data caching based on frequently accessed information.

The Intelligent Response Accuracy (IRA), a metric derived from the kiosk's ability to give contextually accurate and complete responses, was rated at 92%, based on a comprehensive 100-query test. The older system averaged only 75%, with many responses being generic or partial due to limited NLP integration. Our model uses fine-tuned natural language understanding backed by a cloud NLP model (Dialog flow ES + Firebase CMS), ensuring intelligent, context-aware conversations with users.[11]

Furthermore, the modular architecture of the Smart Kiosk enables real-time content synchronization and remote updates through cloud-linked dashboards, reducing downtime and manual input. In contrast, the 2020 system required physical intervention for software or content changes. The inclusion of multimodal interaction i.e. combining voice, touch, and visual displays, sets a new standard for user-centric design in public digital kiosks.

In terms of hardware interfacing and sustainability, our kiosk integrates a Raspberry Pi 4 board with a low-power display system, making it both cost-effective and energy-efficient. Additionally, the inclusion of 3D holographic demonstration of scientific concepts (e.g., diffraction) offers a pedagogical edge over traditional kiosks that simply broadcast static content. This elevates not only the functional aspect but also the educational value delivered by the system. [11]

Overall, the Smart Kiosk presents a state-of-the-art advancement that caters to the modern requirements of educational institutions. It overcomes the limitations of previous systems by delivering low-latency, high-accuracy, real-time, and interactive responses, while ensuring content scalability, modular deployment, and accessibility for all users. This positions the Smart Kiosk as a pioneering solution that enhances institutional visibility, fosters student innovation showcase, and aligns with the evolving digital transformation goals of academia.

VI. CONCLUSION

The Smart Kiosk for Institutional Information is a practical and efficient solution designed to improve how information is shared in academic settings. It combines simple technologies like a Raspberry Pi, touch screen, voice assistant, chatbot, and a website to display student projects and institutional data in an interactive way. The holographic model adds a scientific element by showing the concepts of interference and diffraction in a visual format. The kiosk is easy to use, runs automatically with Full Page OS, and does not need much maintenance. Users can interact through touch or voice, and the content is clear and well-organized.

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