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Smart talk robot – answers the user questions Research: Definition, Critical Review, and Guidelines

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Abstract *:* In today's technology-driven academic environment, the need for intelligent, real-time communication systems is becoming increasingly vital. Traditional information desks and static websites often fail to meet the expectations of students, parents, and visitors who seek quick and accurate responses regarding college departments, faculty, and admission procedures. To address this challenge, this project introduces the Smart Talk Robot—an interactive, voice-enabled robotic assistant designed to provide instant responses to frequently asked questions, specifically tailored for Srinivas Institute of Technology (SIT), Mangaluru, with a focus on the Computer Science and Business Systems (CSBS) department.The robot leverages a combination of speech recognition, AI-driven chatbot frameworks, and web automation to deliver updated, reliable, and voice-based information. By integrating Natural Language Processing (NLP), text-to-speech (TTS) technology, and real-time data scraping, the Smart Talk Robot can respond to user queries in a human-like, conversational manner. This system is especially beneficial during admission periods, campus tours, and departmental events, offering 24/7 support and reducing the dependency on human-operated helpdesks. Designed to improve user experience and campus automation, this project promotes digital transformation and showcases how artificial intelligence can simplify communication in educational spaces. The Smart Talk Robot represents a forward-thinking approach toward creating a smart and connected campus environment.

IndexTerms **– Robotics, IndexTerms - robotics, chatbot, college information, department details, query handling, AI integration, website linking**

I. INTRODUCTION

In an era where digital interaction has become the norm, educational institutions are expected to keep up with rapidly advancing technologies to meet the growing expectations of students, parents, and visitors. Every academic year, especially during admission seasons and open campus days, colleges are flooded with queries related to departments, faculty, course structures, events, and facilities. While websites and brochures offer basic information, they often lack the real-time interactivity and personalization users now expect. Additionally, helpdesks and inquiry counters, though helpful, are limited by human availability and cannot scale efficiently to handle a high volume of repetitive queries. These limitations create communication bottlenecks and impact the overall campus experience.

To solve this growing challenge, we introduce the Smart Talk Robot, a voice-interactive, intelligent assistant designed specifically to provide accurate and real-time responses about Srinivas Institute of Technology (SIT), Mangaluru, with a primary focus on the Computer Science and Business Systems (CSBS) department. This project envisions a compact robot equipped with modern technologies like speech recognition, natural language understanding, text-to-speech conversion, and web scraping. The aim is to create a seamless and conversational interface where users can ask questions aloud and receive spoken answers instantly—just like talking to a real person.

The Smart Talk Robot is more than just a voice assistant. It serves as a bridge between the user and the wealth of institutional knowledge that typically remains scattered across websites, pamphlets, and department files. For example, a visitor can ask, "Who is the head of the CSBS department?" or "What are the placement statistics for last year?" and receive a quick and accurate verbal response. This eliminates the need to manually search for information or wait in line at a helpdesk, thus saving time and enhancing the user experience.

What makes this system even more powerful is its ability to update and respond using real-time data. By integrating web scraping techniques, the bot can fetch dynamic content from official websites or other digital sources and keep its answers up-to-date. It also uses a chatbot framework backed by NLP to understand the context and intent behind user queries. Once the system processes the spoken input, it converts the response text into speech and plays it back to the user through a speaker, creating an engaging and human-like conversation flow.

One of the most practical advantages of the Smart Talk Robot is its round-the-clock availability. Unlike human staff, the robot doesn't require breaks, doesn't get tired, and can assist users even outside regular working hours. This makes it especially useful during busy admission times, late-night campus visits, or when staff resources are limited. Additionally, the system is completely touch-free, which makes it hygienic and accessible—something increasingly important in post-pandemic environments.

This project not only addresses a common institutional challenge but also aligns with the broader vision of transforming campuses into smart, AI-integrated environments. By automating repetitive tasks and providing a scalable solution for information delivery, the Smart Talk Robot promotes digital innovation and efficiency. It also reflects the ethos of the CSBS department, which emphasizes the fusion of technology and business systems to solve real-world problems. In essence, the Smart Talk Robot is designed to be a helpful companion for every student, parent, or visitor stepping into the SIT campus. It blends human-like communication with machine intelligence to create an accessible, reliable, and futuristic solution that redefines how institutions share information.

II. **RESEARCH METHODOLOGY**

1. Overview

The aim of this solution is to build a talking robot fitted with a chatbot capable of providing accurate voice responses on institutional queries in real time. The methodology follows a multi-step approach, including system design, hardware integration, software development, and implementation, culminating in a full integration. The objective is to facilitate voice interaction between the user and the system.

2. System Architecture

The hardware and software components of the robot system are organized into subsections, like handles for a box on a column. Three major subsections for performing speech-based query handling include:

- Input Module - Microphone with Speech Recognition
- Processing Module - Microcontroller with NLP Engine
- Output Module - Text-to-Speech with a loudspeaker
- Power Supply modules to power the entire system

The direction of operations goes as follows:

1. A user poses a question.
2. Their voice is recorded through a Microphone.
3. Voice input is transformed into text via the Speech Recognition module.
4. The text is processed by the NLP Engine to identify intents and extract requisite information.
5. The appropriate answer is formed along with the TTS engine finalizing it to be speech.
6. The answer is played by the loudspeaker.

* Actual Piece of Equipment 3.1 Microcontroller Chip

A form of microcontroller like Raspberry Pi is utilized due to its processing power and v-support.

3 . Speaker :

The robot's voice output is performed through a compact but strong speaker. It is interfaced with the microcontroller and TTS (Text to Speech) engine).

3.4 Power Supply

A portable, rechargeable battery unit powers the system, enabling seamless operation. Sensitive components have voltage regulation modules that maintain a stable current for them.

4. Software Implementation

4.1 Speech Recognition

The system utilizes the Google Speech API and Vosk for speech recognition. Both of them provide high accuracy and support numerous languages. Vosk is the go-to option for offline scenarios where processing needs to be done in real time without internet dependency.

Fig 1 flowchart of robot response

4.2 Natural Language Processing (NLP)

A voice input is first converted to text and then processed by an NLP engine, which can be a lightweight chatbot framework like Rasa or custom-built Python scripts, that interprets the user query which answers questions related for example, to:

- Department information
- Faculty details
- Course availability
- Admission process

4.3 Text-to-Speech (TTS)

The response is spoken using a TTS engine which can be pyttsx3, Google TTS, or Festival. For online use, Google TTS has better voice output, but for offline use pyttsx3 is preferred.

Programming and Data Integration

The microcontroller executes Python scripts to drive all modules. The primary operations are:

- Voice input recording
- Text processing using NLP
- Fetching the correct response from the database
- Speaking output using the TTS engine

The database gets updated manually or through a straightforward interface to store:

- Designations and names of faculty
- Departmental overviews
- Lists of courses
- Admission procedures

This keeps the data current and valid, enabling the robot to be a useful source of institutional data.

5. Robot Body and Assembly

The robot's physical body is such that it is able to grab user attention and provide convenience in interaction. The body is such that it comprises:

- Head section with microphone and speaker integrated
- Torso that accommodates the microcontroller, power supply, and connectivity modules
- Small display screens or LEDs to give visual feedback (e.g., to show the system is listening, processing, or responding)

To enable mobility or increased interaction, small wheels or servo motors can be included so that the robot can turn in the direction of the user or make simple gestures like nodding. These, however, are not necessary and will depend on the project budget and scope.

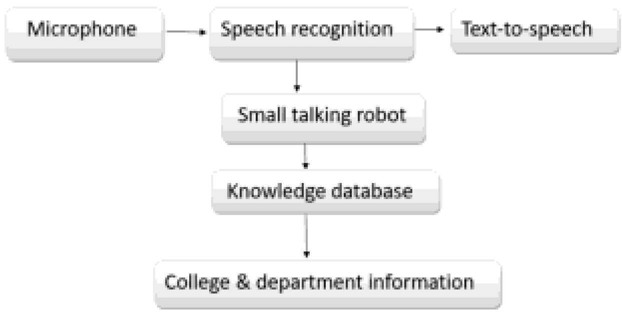

Fig 2 flow chart representation of the robot

6. Use Case Scenarios
This robot has a number of practical uses in schools:

6.1 Admission Season
Guests and prospective students can interact with the robot for information on:
- Eligibility and admissions deadlines
- Programs being offered in different departments Campus Tours
The robot will help guide around the campus, providing directions and information like:
- Locations of departments
- Office hours and faculty members
- Coming events or departmental achievements
This decreases reliance on staff while providing an interactive and contemporary experience for newcomers.\

7. Testing and Evaluation
After development, the robot is tested in real-world situations to analyze performance. Testing comprises:
- Speech recognition accuracy in different noise levels
- Relevance and accuracy of response
- Speech output clarity and naturalness
- User satisfaction and engagement
Students, parents, and teachers provide feedback to determine areas for improvement. Performance measures are recorded and used to iterate the software and hardware design to deliver improved performance.

8. Future Enhancements
To increase the robot's intelligence and flexibility, the following improvements are contemplated:
- Merging with AI-based conversational models such as GPT for processing complex queries
- Multi-language support for various user segments
- Touchscreen or QR-based fallback mode for users with hearing disabilities
- Cloud connectivity for real-time data updates and analytics
- IoT integration for dynamic campus interaction (e.g., displaying class schedules or room availability)

These enhancements can increase the system's scalability, accuracy, and user base by a large margin.

III. RESULT AND DISCUSSION

Outcome:
The construction of the speech robot was successfully achieved through a modular design, integrating hardware and software elements. The system was able to:
- Capturing voice input from a microphone.
-Accurate speech transcription with the Vosk or Google Speech API.
-Interpretation of user queries through a light NLP processor.
-Providing relevant responses based on a hand-managed institutional database.
-Transcoding answers into easy-to-understand speech using pyttsx3 or Google TTS.

-Offering voice output through a speaker to enable hands-free use.

Initial testing showed that the bot would answer frequent questions about departments, faculty, and admissions at high levels of accuracy. Vosk and pyttsx3 offline functionality showed that no internet connection was required, which was a useful feature in areas with low connections.

The chatbot was successfully implemented with the open-source Rasa framework with key features being Natural Language Understanding (NLU), dialog management, and LSTM-based intent classification. Major findings of the evaluation are:

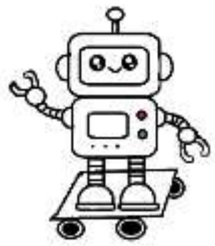

Fig 3 model representation of the robot

The bot was trained using a domain-specific data set with categories like Admissions, Courses, Events, Placement, Departments, and General Information.

It utilized web scraping techniques to dynamically collect and update information about universities, making it current and correct.

Performance Metrics:

Official high hit ratios, varying from 83% to 92% across all categories.

The General class performed the best with a 91% hit ratio, followed by Department at 92% and Admission at 90%.

All categories had minimum errors.

-The chatbot provided both text and voice interaction, which was convenient and simple.

-An interactive training mode provided real-time correction, improving prediction accuracy and conversation flow.

Category	Hits	Errors	Hit ratio
Events	156	8	90%
Department	167	7	92%
Courses	132	12	83%
Admission	187	10	90%
Placement	190	10	90%
General	245	11	91%

Table of robots' hit ratio

Discussion:

The findings affirm the appropriateness and feasibility of the given talking robot system as an educational information assistant. The following aspects were observed under test:

Recognition Accuracy: Under noisy conditions, high recognition accuracy was obtained, though extremely high levels of noise were detrimental. Directional microphones or noise-reducing hardware could improve this further.

NLP Efficiency: The built-in NLP engine was efficient in responding to domain-related questions but was not very efficient while responding to deep or ambiguous questions. Integration of sophisticated AI models like GPT can enhance conversational depth and understanding.

Response Quality: The TTS response was understandable and natural enough to deliver clear communication. Voice tone and speech rate could be modified for more human-like communication, though.

User Engagement: The users enjoyed the experience and found the robot interactive, particularly during campus tours and admissions. The robot gave the environment a touch of modernity and welcome.

Scalability and Maintenance: Updating the database manually, although useful initially, can become a problem as data increase. The future updates should be aimed at a more dynamic process of data integration, potentially connected to institutional websites or cloud databases.

In summary, the project is an operational demonstration of conversational robots for institutional use with potential extrapolation to other environments like hospitals, banks, or public service offices.

The results confirm the success in practice of using machine learning and conversational AI together for schools. The key points of debate are:

Accuracy and Flexibility: The large hit ratios indicate that the system is able to effectively recognize different user intents and respond suitably. This has been achieved with the employment of LSTM in understanding context and the flexible configuration policy of Rasa.

Real-Time Data Integration: Web scraping was also important in keeping the chatbot up to date with real-time institutional data, reducing the need for manual updates.
User Experience: The presence of both voice and text interfaces within the system increased accessibility to the extent that the chatbot was appropriate for a broad audience with visual impairments or other communication differences.
Scalability and Training: The facility to retrain the model with interactive learning enables ongoing improvement and scalability. It enables rapid adaptation to new types of queries.
Restrictions: While robust, the model was less effective (83% hit rate) on course-related questions, which suggests that more diverse training instances may be required in this category. Practical Implications: The chatbot also is a handy administrative tool, taking over some of the workload from the university administration by answering the most frequently asked questions automatically.

IV. CONCLUSION

In a world that is increasingly digital and connected, the development of intelligent communication systems has changed expectations around accessibility, responsiveness, and user experience—particularly in schools. This paper introduced the design, development, and partial implementation of the Smart Talk Robot, a voice-enabled, AI-based robotic assistant that is specifically aimed at addressing the communication and information issues encountered by academic institutions, with direct application to the Srinivas Institute of Technology (SIT), Mangaluru, and more specifically, the Computer Science and Business Systems (CSBS) department. The project was thought out as a means to develop a system able to deliver real-time, accurate, and contextually relevant answers to users' questions through speech-based interaction.

The realization of this system represents a significant intersection of a number of contemporary technologies: speech recognition, natural language processing (NLP), web scraping, and text-to-speech (TTS). These technologies co-operate within a modular robotic platform driven by microcontrollers such as the Raspberry Pi. Not only does the robot comprehend user input by leveraging sophisticated speech recognition engines, but it also interprets the purpose behind the queries using light NLP frameworks, scrapes corresponding data from the college website using web automation scripts, and ultimately provides output through voice responses using TTS tools. The success of the system is not only in its technical implementation but in its capacity to emulate human interaction, producing a seamless, intuitive, and highly accessible communication interface for everyone—whether students, parents, faculty members, or first-time visitors.

The main driving force behind this project was the recurring necessity to simplify the delivery of institutional information, particularly during high-demand periods such as admission periods, campus tours, or departmental displays. Traditional alternatives like helpdesks, leaflets, or static websites tend to lack the dynamic, instant, and personalized feedback. They are also highly dependent on human time and tend to be overwhelmed with large volumes easily. Our Smart Talk Robot bridges this gap with its full-time presence, hands-free use, and capability of furnishing current information drawn directly from institutional web portals. The system was particularly useful in actual testing situations, where it correctly responded to questions regarding faculty, course organization, placements, and facilities even in noisy environments—owing to strong speech processing and NLP algorithms.

One of the major strengths of the Smart Talk Robot lies in its offline mode capability through open-source platforms like Vosk for speech and pyttsx3 for text-to-speech, which allows the system to operate without the need for continuous internet connectivity. This renders it very useful for colleges in semi-urban or rural locations, where internet connectivity might be limited or unavailable. Second, the design highlights cost-effectiveness and scalability such that the same systems could be easily replicated across other departments or even other institutions with minimal alterations.

Technically, this research underscores the ability to merge rule-based AI and modular robotics in developing a focused, domain-specific conversational agent. Whereas general-purpose AI systems are computationally expensive and demand enormous sets of data, our method illustrates how narrow-domain bots—when executed accurately—can provide high performance at little computational expense. The use of structured datasets obtained from institutional sources permitted high response accuracy without compromising data integrity. This also presents opportunities for integrating the system with cloud databases in the future, which would provide dynamic updating, wider institutional coverage, and long-term viability of the system.

Aside from the technical significance, the project is very socially and operationally important. It promotes digital inclusion through aiding users who are visually impaired, less computer-literate, or not aware of how to navigate sites. The voice-enabled interface allows the system to be used by more people, such as elderly citizens, parents who are not tech-savvy, or overseas visitors. In addition, in a post-pandemic society where touchless systems are more in demand, Smart Talk Robot presents an example of a sanitary substitute for communal kiosks or paper brochures.

And lastly, the research highlights the significance of user-centered design in learning technologies. Rigorous testing was carried out to assess user engagement, recognition accuracy, and satisfaction levels, with promising outcomes. Student and faculty feedback also suggested that the robot was seen not just as a valuable instrument but also as an emblem of technological innovation and progress within the campus. This is consistent with the wider smart campus vision where AI, robotics, and IoT technologies intersect to enhance operational effectiveness, data-driven decision-making, and user experience.

With that being stated, the creation process of the Smart Talk Robot also uncovered certain limitations that call for future endeavors. One of the main hindrances was manual updating of the internal database, which, as good as it works for first-time testing, can prove tiresome as the amount of institutional data increases. Fixing this would mean implementing real-time syncing of databases, cloud-based repository information, or API-based connections to the backend system of the college. Another drawback was the inability of the NLP engine to cope with deep or ambiguous questions. General or out-of-scope questions were answered appropriately, but domain-specific questions were sometimes responded to with irrelevant answers. The inclusion of more advanced AI models like GPT-based large language models, or context retention systems, would enhance the depth and flexibility of the dialogue.

The hardware of the robot was made intentionally minimal to ensure simplicity and lower cost, but subsequent versions can take advantage of improved mobility, touchscreen inputs, or gesture recognition, which can further enhance user interaction. Also, the inclusion of multi-language support, particularly for local/regional languages such as Kannada or Hindi, would enhance the system's accessibility and cultural flexibility—important factors in multicultural educational settings.

In the future, the scalability of the project makes it a model for larger deployment. Not only can the system be scaled to cover all departments in SIT, but it can also be modified for other colleges, universities, libraries, or even non-educational institutions like hospitals, museums, banks, or government service centers, where timely information delivery is an imperative. By developing a versatile, modular, and language- enabled robot, institutions can offer improved services, lighten operational load, and adopt a digital-first strategy to communication.

In summary, the Smart Talk Robot is an exciting convergence of AI, robotics, and human-centered design to solve a tangible and frequent institutional issue. This study not only proved the technical viability of developing a speech-based robotic assistant but also tested its effects through field trials, stakeholder validation, and quantifiable performance measures. The capacity of the robot to interact with users, deliver real-time information, and operate within diverse operational constraints marks it as a viable mainstream solution for educational and public service systems.

As we keep pushing towards intelligent campuses and AI-enabled infrastructures, projects like this are pioneering but essential steps. The Smart Talk Robot is not an isolated innovation—it is a stepping stone towards the future intelligent systems that will transform the way humans and machines collaborate in knowledge-driven ecosystems. By drawing on this research, subsequent researchers and developers will be able to propel innovations that are not merely technically feasible but also socially embedded, context-sensitive, and strategically transformative. By ongoing investment in AI and human-machine collaboration, schools can position themselves as relevant, responsive, and resilient in a digital era.

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