

CHAPTER I

INTRODUCTION

1.1 Project Background

The evolution of Artificial Intelligence (AI) in recent years has radically changed how digital customer service systems are designed and launched. A significant number of businesses have now begun employing AI-based customer service systems, and in particular conversational agents and chatbots to respond faster, automate repetitive enquiries, standardise service quality and availability beyond office hours.(Caldarini et al., 2022; Følstad & Taylor, 2021; Hsu & Lin, 2023).

Users expect correct, immediate and consistent replies in modern service environments. Customer service systems that rely solely on human agents can be limited in their effectiveness, e.g., slow response times, not enough team members available to handle calls, inconsistent answers across teams, etc. Newer research on AI chatbot service quality means the assessment of chatbot performance also be seen from technical quality/conversational ability, user satisfaction and service experience rather than functional automation.(Følstad & Taylor, 2021; Hsu & Lin, 2023).

Customer service is critical in higher education where it serves as a vital support system that helps students, prospective students and visitors with information regarding academic programmes of study, admission process, faculties, tuition fees, facilities and general university services. University EnquiriesThe university still receives thousands of similar questions almost every day. Almost everything else in business is done through automation which can handle tasks that make the service slower and more capable only when human staff are available to do them. Hence, AI-powered chatbots may assist university information services by delivering on-time responses to standard and common

questions(Hwang & Chang, 2023; Okonkwo & Ade-Ibijola, 2021; Wollny et al., 2021).

Recent developments in Natural Language Processing (NLP) and Large Language Models (LLM)s have significantly enhanced conversational systems to achieve semantic understanding of user input, follow-up on a conversational context, and produce language that sounds natural. This also makes LLM-based chatbot systems more flexible than traditional chatbots, as the latter are rule-based and restrict user patronage of response where they expect a certain format or structure by work type.(Chang et al., 2024; Singh & Namin, 2025).

Additionally, recent evaluations highlight the need for caution in using LLM-based systems as chatbots given that these characteristics, models and prompts used, and evaluation techniques significantly impact response acceptability. (Chang et al., 2024; Singh & Namin, 2025).

Besides textual interaction, voice-enabled conversational systems have become more relevant. Voice interaction also has some benefits in improving accessibility and interactiveness for users who are more comfortable with using their words than typing, visual or motor limitations, or anyone who needs hands-free communication. Research in voice assistants powered by large language models (LLMs) suggests that voice interaction supports richer interaction patterns, but the use of speech can also pose new challenges around speech recognition and breakdown handling during responses. (Kumalija & Nakamoto, 2022; Mahmood et al., 2025; Roger et al., 2022).

Speech-to-Text (STT) allows a chatbot to replace spoken input with text. This is particularly demonstrated by modern STT systems, including Whisper based models, which are found to have strong robustness in the multilingual and multitasking speech recognition settings (Kumalija & Nakamoto, 2022; Roger et al., 2022). Text-to-Speech (TTS) uses to transform the text responses in an audio output. Recent research on TTS (Barakat et al., 2024) indicate a gradual shift from

naturalness in speech synthesis towards controlling certain attributes of synthetic speech (emotion, style, speaker characteristics and expressiveness).

Regardless of these technical strides, many customer service chatbots used today are still mainly text based or generically defined. This is an issue of great importance in the context of the University's customer service, where users often want to find the information they need quickly and at the level they need, in the specific content they are interested in. Sophisticated chatbot features are available in commercial platforms, but at a price, depends on the cloud, and are less flexible for deployment in academic prototype evaluation(Caldarini et al., 2022; Singh & Namin, 2025).

This project aims to building AI-Based Customer Service Chatbot with Voice and Text Interaction for Management and Science University (MSU) in order to solve these problems. Its architecture is a single dialog system that houses all of Speech-to-Text, Large Language Model and Text-to-Speech components. Use llama-3 as AI service provider in GroqCloud API in this project. 1-8b-instant is used as the LLM for response generation, and whisper-large-v3, as an STT model for processing voice input. This proposed system allows contactless customer service in the university.

1.2 Problem Statement

Although many digital customer service systems are developing and being commonly applied, issues remain at university information services. To begin with, a significant part of your university customer service tasks still relies heavily on human agents while dealing with repetitive queries like academic programmes, admissions, faculties, tuition fees and facilities & generic institutional information This dependency could cause slow response times, limited access to services during non-office hours and varied answers due to the nature of enquiries toward peak periods. This can be diminished in some degree by embedding AI-based

chatbot systems which help automate routine enquiries and improve service availability. (Følstad & Taylor, 2021; Hsu & Lin, 2023).

Second, most existing chatbot systems are text-based. Text-based chatbots can be automated for simple text-based enquiries, but may not satisfy the needs of users who wish to communicate via speech alone, or of users who might have difficulty typing. The relevance of voice interaction is based on the claims that it enhances the naturalness and accessibility of verbal and non-verbal communication, while voice-based systems can raise new issues for speech assertion reliability, latency, tight or premature term separation. (Kumalija & Nakamoto, 2022; Mahmood et al., 2025; Roger et al., 2022).

Third, current implementations of chatbots are either for general-purpose conversation systems, or commercial chatbot platforms. The development and empirical investigation of a domain-specific university customer service chatbot that incorporates Speech-to-Text, Large Language Models, and Text-to-Speech within an integrated voice and text interaction framework has received limited attention. New research points to the need for systematic evaluation of LLM-based chatbots across technical and user-centered metrics like response accuracy (the ability to provide accurate content), usability (ease of use) interaction quality, and user acceptance. (Belda-Medina & Kokošková, 2023; Chang et al., 2024; Singh & Namin, 2025).

As a result, this project proposes to create an AI-Based Customer Service Chatbot by using Voice and Text Interaction for Management and Science University. Yes, the system will be a voice and text support with contextually important responses generated from llama-3. 1-8b-instant via GroqCloud API, var input = whisper-large-v3 to process voiceinput, var result = functional testing + answer quality test + latency evaluation + STT quality assessment + user experience research + User Acceptance Test

1.3 Project Objectives

The objectives of this project are as follows:

1. To integrate Speech-to-Text (STT) and Text-to-Speech (TTS) technologies to enable natural and real-time voice interaction in the AI-based customer service chatbot.
2. To develop an AI-driven conversational system using a Large Language Model (LLM) capable of processing user input and generating coherent, relevant, and contextually appropriate responses for university-related enquiries.
3. To evaluate the system's performance, usability, and user acceptance through functional testing, response accuracy assessment, response time analysis, STT evaluation, usability testing, and User Acceptance Testing.

1.4 Project Scope

This project aims to create an AI-powered text and voice chatbot for customer service in a university setting. This paper describes a proposed implementation of an automated question and answer dialogue system which has been developed as a case study at Management and Science University (MSU) to support automated responses related to academic and administrative enquiries from students.

It helps students, prospective students and visitors to get access on faculties, academic programmes, admission procedure, facilities and general university services at MSU. Rather than develop into a generic chatbot, the system is targeted to a particular customer service area — University information services. Why domain-specific design matters: The information that guides the conversation of a chatbot influences response quality; therefore, it is vital that chatbots have an appropriate knowledge base (Hsu & Lin, 2023; Okonkwo & Ade-Ibijola, 2021; Singh & Namin, 2025).

This project is only for a basic prototype development and assessment in an academic environment. The goal is not for complete commercial deployment or production-level pilot. It sets out to prove the possible, practical and palatable use of an AI based voice and text customer service platform in a genuine institutional context.

1.4.1 System Scope

The scope of the system for this project is to design and develop an AI customer service chatbot that allows a user to communicate bi-directionally with the intelligent assistant by sending/receiving both text and voice input/output. This system becomes an AI Virtual Customer Service Assistant for Management and Science University that provides information around faculties, programmes of study, universities entrance requirement to all types of facilities and academic services.

The main components of the system architecture are as follows. The User Interface is through which users can make an enquiry either by text or speech using a web-based interface. Using this interface, students can ask questions about the programmes that are on offer, details of the faculty, admission requirements and other MSU services.

The Speech to Text (STT) uses whisper-large-v3 behind the scenes (aka, market-leading ASR) to convert spoken voice user input into a textual representation. This makes Whisper-based speech recognition models relevant to this project as it provides generally better speech recognition in a variety of different speech conditions (Kumalija & Nakamoto, 2022; Roger et al., 2022). Here, the STT module converts user voice input to text and then passes that query to the chatbot system for processing.

It is based on Large Language Model via GroqCloud API; Text Processing Module. In this project, the llama-3. The model 1-8b-instant, which is the one you will be using for this function. This model has been trained on user queries and

responses as provided in relation to MSU academic programmes, faculties, admissions related information and general university services. Considering the importance of rapid response generation in the presence of a real-time customer service interaction (Chang et al., 2024; Singh & Namin, 2025).

Text to speech module — this converts the text that is system-generated responses to voice outputs. You can learn until October 2023, where TTS enables voice interaction as well as increased accessibility for those who prefer audio responses. Recent TTS research suggests while speech synthesis quality is important in natural and user-friendly voice interaction (Barakat et al., 2024) there are other factors affecting the speech synthesis experience.

The Backend Integration Layer is responsible for the flow of data, user session, API calls to interact with AI-based services as well as managing communication between your front end and back-end. As an example, it allows managing requests and responses efficiently and securely by way of the customer service context.

This system is supported by the informational and enquiry-based interactions. It is also not transactional whereby students register for courses, pay tuition fees, disclose their academic information; or that comes with pre-approved administrative sanction. Human customer service personnel will still be needed for complex or sensitive enquiries.

1.5 Project Significance

The AI-Based Customer Service Chatbot with Voice and Text Interaction proposed herein contributes substantially in practical as well as academic ways to the field of higher education customer service.

In practice, the dual modes of interaction between user and university information services (namely text-based and voice) enhance accessibility. It allows students, prospective students and visitors a convenient way to find out

more about the information. For example, for people who have difficulty typing, voice interaction is a solution (Kumalija & Nakamoto, 2022; Mahmood et al., 2025; Roger et al., 2022).

Operational-wise, the AI chatbot can also be programmed to address repetitive queries regarding academic programmes, faculty information, admission-related queries, University facilities, and general service queries without human intervention. This frees up human customer service team to attend more complex inquiries that require human judgement. The second stream of research examines the quality of service provided by the AI chatbots, and suggests that AI chatbots impact service productivity and customer satisfaction (Følstad & Taylor, 2021; Hsu & Lin, 2023).

Academically, this project helps the fields of conversational AI and Human-Computer Interaction (HCI) research, by demonstrating how to create a multimodal chatbot for a specific domain: A multi modal chatbot on higher education. Not only does this project provide a working prototype of a chatbot, but it also evaluates the usability, accuracy of its answers, and performance and acceptance of the user's voice. We stay within the boundary of chatbot systems and draw attention to systematic testing with an emphasis on user-centered evaluation as these are imperative that needs completion before real-world use (Belda-Medina & Kokošková, 2023; Chang et al., 2024; Hwang & Chang, 2023; Singh & Namin, 2025).

Another reason for user acceptance is that the success of an AI chatbot in higher education requires not only exceptional technical performance (better grammar, spelling, and punctuation than a human), but also perceived usefulness, trustworthiness, satisfaction, and behavioral intention to use the system more persistently in resembling work experience (Shahzad et al., 2024; Tian et al., 2024). Thus, this study provides a two-fold contribution: as an integration of voice and text-based systems in terms of system architecture, and also as a measure of the effectiveness in AI interaction.

1.6 Chapter Summary

This chapter illustrated The Background of AI-Based Customer Service Chatbot with Voice and Text Interaction. This part deals with the history of and rising need for effective, easily-accessed and consistent customer service in an academic context—specifically around common student questions pertaining to programmes, admissions & cut-offs, faculties, facilities and university in general.

In this chapter, the key issues tackled by this project were also presented. Chapter 1. Introduction therefore text based chatbot systems have their limitations a system which can work without dependency of human customer service agents is required. A system which is an integrated voice and text based conversational system. From these issues, three project objectives were identified to guide the development and evaluation of the chatbot system.

As shown in Figure 3, the scope of the project involved creating a working prototype for Management and Science University on providing informational- and enquiry-based services rather than transactional processes within university. From a practical and academic point of view, project significance was also discussed in the context of accessibility, service efficiency, conversational AI and Human Computer Interaction..

The following chapter presents literature review, technologies, present systems and similar products/research gaps to provide a basis for creating the proposed AI-based customer service chat solution.