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Using AI Chat Bots to Assist Callers During Emergencies

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Abstract: Large language models (LLMs), such as ChatGPT, have attracted widespread public interest due to their perceived benefits and concerns. Although the potential contribution of LLMs to healthcare has been widely discussed, few studies have carefully examined the application of LLMs, including their use in the personal agreement process. This study evaluated the effectiveness of LL.M students, ChatGPT 3.5, ChatGPT 4.0, and Gemini in creating information on the anesthesia process. It is a pity that despite many attempts no LLM has been able to produce legal documents and the reserve for risk prevention, disclosure, and planning remains inadequate. Therefore, the LLM now clarifies the limitations in practical use, particularly in changing the patient's risk classification by agreement. Interactive agents, including chatbots and interactive voice interaction (IVR), have made significant progress and promise further to advance human-machine interaction, especially in emergency procedures. This article describes a two-manned emergency solution for short-term emergencies using Free Pass IVR and the Bot press chatbot platform, a multi-purpose solution. The solution was evaluated in Romania to demonstrate quality of service (QoS) and effectiveness of service management. Additionally, proof of concept (PoC) was assessed using real data, focusing on current and valid emergency calls in Romania. According to the feasibility study, the PoC is ready to integrate into Romania's emergency; The IVR phone is best suited to the requirements of the country's system.

Keywords: Large language models (LLMs), Chat Agents, Chatbots, Interactive Voice Response (IVR), Bot press, Digital Health Assistants

Introduction

Literature Review

The modern years have witnessed top notch increase in virtual transformation driven through enhancements in synthetic intelligence (AI), internet of factors (IoT), cloud and location computing, 5G community and other technology, and so forth. These innovations have stimulated significant developments in human-computer interface design. Of particular note is the potential impact in healthcare, where discussions about the contribution of AI models including large language models (LLMs) such as ChatGPT have developed but despite claims broadly, comprehensive research examining the practical application of LLMs, particularly in areas such as informed consent for all [25]. The integration of AI technologies into each day sports, specifically inside public offerings, holds substantial promise for enhancing productivity and user delight at the equal time as decreasing costs. Intelligent marketers, together with chatbots and Interactive Voice Response (IVR) structures, have emerged as pivotal additives of this digital revolution. Chatbots engage customers through text or voice using Natural Language Processing (NLP), at the same time as IVR systems facilitate interaction with laptop-operated mobile phone structures thru voice or keypad inputs [10]. Businesses are using chatbots and IVR systems to streamline operations and improve efficiency. These systems are being implemented across various domains, from support systems and education to healthcare and cultural heritage. However, implementing such policies in emergency situations presents unique challenges. As shown in Figure 1, the image provides an overview of some of the most well-known chatbot assistants, each represented by a circular icon with its name displayed. In times of emergency, timely green assistance from the federal government is paramount, thus requiring rapid call management and thorough field investigations. But emergency call centres face a high volume of calls on a regular basis, including true emergencies, pocket calls, and frantic calls [19].

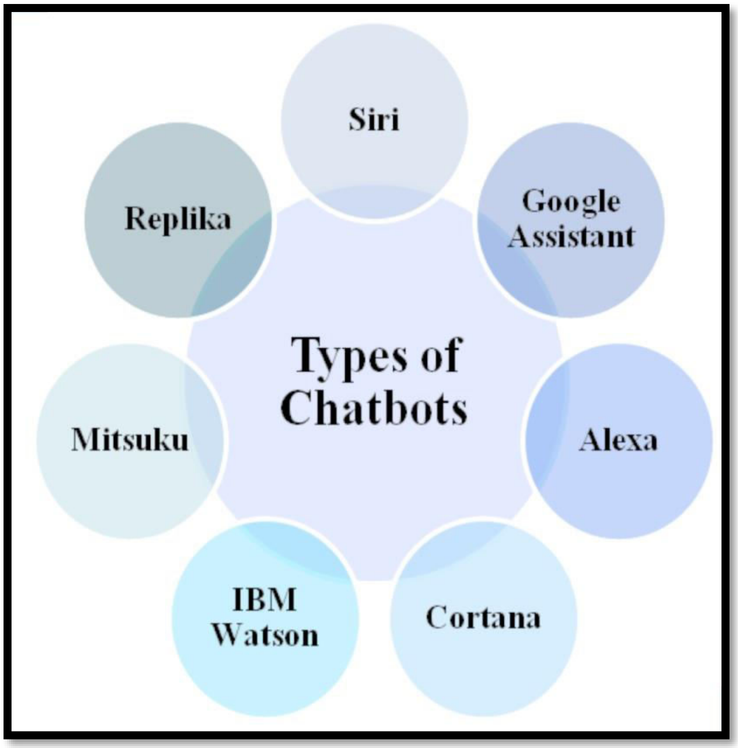

Figure 1: Common Types of Chatbots This image provides an overview of some of the most well-known chatbot assistants, including Replika, Siri, Google Assistant, Mitsuku, IBM Watson, Alexa, and Cortana. Each chatbot is represented by a circular icon with its name displayed below.

AI tools provide promising solutions to cope with those challenges with the aid of analysing calls and messages, reducing waiting times, and assisting operators in right away figuring out important situations. For instance, research in Denmark spotlight the potential of AI in early detection of cardiac arrest instances, thereby improving survival costs. Building on these insights, countries like Belgium and the United Kingdom have applied IVR solutions to streamline emergency call dealing with, yielding promising consequences. The above mentioned are the varieties of Chatbots [18]. However, integrating chatbots and IVR systems into emergency contexts affords vast challenges, consisting of time constraints, resource control, person pride, and compliance. In this paper, we purpose to discover the development and implementation of interactive chatbots/IVR solutions tailored for emergency systems, with a selected consciousness Romanian National Emergency System 112 within the scope of the ODIN112 project. Through exact critiques and comparative analyses, we are searching for to contribute to the development of AI-enabled emergency response systems [11].

The utility of AI chatbots in emergency services is a swiftly developing field, with numerous studies and implementations highlighting its ability to decorate reaction times and useful resource efficiency. AI-driven emergency reaction structures leverage advanced technologies including natural language processing (NLP) and system getting to know to automate the dealing with of emergency calls. These structure intention to provide quicker, extra green responses as compared to conventional techniques. For example, research has explored using AI in emergency control, highlighting the capability for AI to streamline communication and selection-making procedures in the course of crises [24]. The Interactive Voice Response (IVR) systems have been widely utilized in the emergency services to manage the high volumes of calls. They provide an automated approach for name routing and records accumulating, that could considerably lower the burden on human operators. Previous research verified effectiveness of IVR systems in handling the emergency calls through improving the reaction times and accuracy [15, 2]. The ODIN112 project's telephony IVR solution builds on this foundation, giving more detailed decision tree to handle various emergency scenarios more effectively [16]. Resource consumption is a vital factor in the deployment of AI solutions for the emergency services. Efficient use of central processing unit (CPU) and memory can asses' growth of the overall performance and reliability of these structures. The Studies have proven that optimizing the useful resource utilization is essential for retaining the excessive performance in the AI-driven applications. The ODIN112 mission's evaluation of resource intake found out that the telephony IVR answer is greener than the web-based chatbot, the use of 16% less CPU load and 38.45% much less memory on average [23].

User satisfaction and trust are essential to successful implementation of emergency management systems. Research shows that users are more likely to adopt and trust AI solutions if they are reliable and efficient [8]. The importance of system reliability has been emphasized with the use of reliability in the adoption of automated systems is emphasized in previous research. The ODIN112 project aims to evaluate these aspects through pilot projects, evaluating user satisfaction and confidence in IVR solutions in a real emergency situation [13]. Comparative research between wonderful emergency response systems provides precious insights into their effectiveness and overall performance. For example, an evaluation between the ODIN112 mission's IVR answer and the Belgium IVR Options Menu discovered that the previous gives a more complex and complex choice tree, enabling it to deal with emergencies with extra specificity and accuracy. Such comparisons underscore the significance of tailor-made solutions that meet particular requirements and overall performance metrics [7]. The literature shows that AI-driven emergency reaction systems, especially the ones leveraging IVR era, provide tremendous advantages in phrases of aid performance and response instances.

The ODIN112 assignment's telephony IVR answer exemplifies these advantages, outperforming the internet-based chatbot in key metrics. Future studies and pilot tasks will further investigate person pleasure and machine reliability, contributing to the broader adoption and refinement of AI technologies in emergency offerings [9].

Chatbot technology has evolved significantly since its inception, with its origins dating back to Alan Turing's Turing Test in 1950. Early chatbots like ELIZA model designed to mimic a psychotherapist and subsequent versions like PARRY and ALICE laid the groundwork for modern conversational agents. The emergence of virtual intelligence assistants Technologies such as Apple Siri, Microsoft Cortana, Amazon Alexa, Google Assistant and IBM Watson are accelerating progress in this field [26]. Recent research has delved into various methodologies for chatbot development. These include pattern matching, exemplified by ELIZA and ALICE, AIML-based systems utilizing XML-based dialogue units, and NLP/NLU-based approaches like RASA and Bot Press. Experimentation with Romanian conversational agents have yielded promising results, with studies showcasing RASA-based agents capable of communicating in predefined microworlds and retrieving information using graph-based non-relational databases [17].

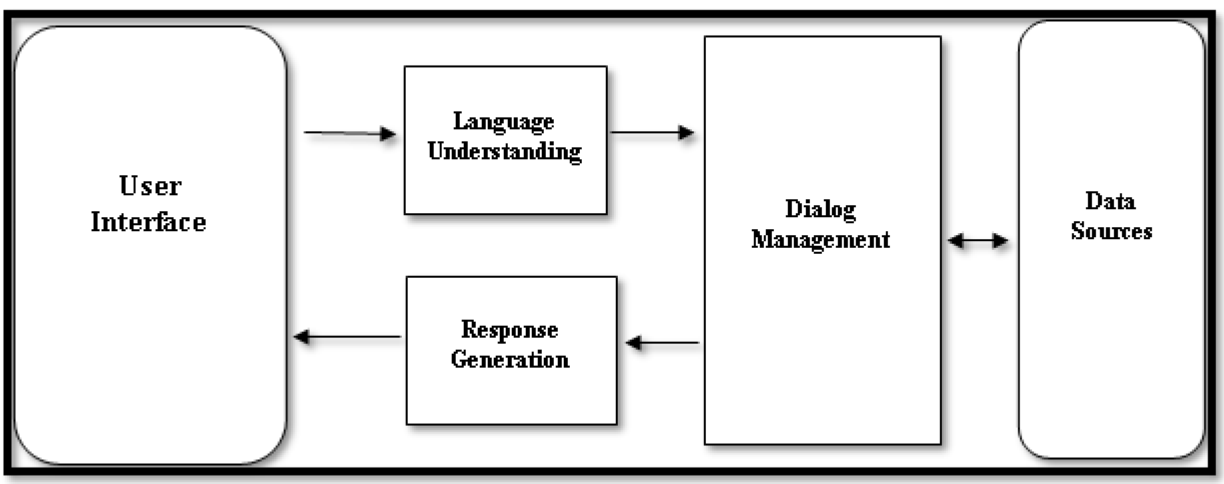

Figure 2: General Architecture of Chatbots; This figure illustrates the general architecture of chatbots. The key components include the user interface, language understanding, dialog management, response generation, and data sources.

Adamopoulou and Moussiades proposed a comprehensive chatbots architecture comprising language understanding as in figure dialog management, and response generation modules [5]. The general architecture of chatbots, as depicted in Figure 2, consists of key components such as the user interface, language understanding, dialog management, response generation, and data sources. Additionally, Belda-Medina and

Calvo-Ferrer investigated end-user satisfaction with AI-based educational systems, while Boroghina, Corlatescu, and Dascalu developed an emotion-recognition system for therapeutic chatbots [16].

Platforms for Building Interactive Agents and Romanian Chatbot Solutions

Many platforms facilitate the development of interactive agents. Rasa, the open principle that provides the means of word formation, message understanding, and conversation management [3]. Microsoft Bot Framework, coupled with Microsoft Cognitive Services, offers SDKs and services for both development and natural language processing. Botpress enables visual and code-based development of chatbots solutions, boasting fast execution speed and support for various communication channels [6]. Romanian companies like Druid and Holisun offer AI-based conversational agent platforms tailored to specific domains. Druid's platform features a proprietary NLP/NLU engine for building virtual assistants with high accuracy and real-time contextual understanding. Holisun's AIDA.AI platform integrates intelligent chat capabilities, automated assistance, and knowledge base management, with successful implementations across sectors like education and healthcare [22, 20]. The emergence of digital assistants such as Apple Siri, Microsoft Cortana, Amazon Alexa, Google Assistant and IBM Watson has made progress in this field. These include improved response efficiency, 24/7 availability, and reduced reliance on human operators through machine learning-driven automation [12]. These solutions demonstrate the potential of AI chatbots to improve user experience and efficiency in many areas, including emergency response.

Methodology

Requirements, Specifications, and Architecture Design

Designing an effective emergency communications voice response (IVR) system requires careful consideration of specific requirements and specifications for emergency situations, which differ from corporate chatbots in key features Must meet critical deadlines is tightly controlled and all emergencies are dealt with promptly without emergencies 100% call control ensured that [1]. Additionally, the system must work well for many emergency calls with a limited computer. Additionally, availability hours are important in terms of coverage and (24/7) accessibility. Get right of entry to is the percentage of end customers who can log into the gadget and engage without delay with the operator's information. Desk 1 describes the capability and necessities of chatbot/IVR answers for calls to emergency companies identified through the Romanian ODIN 112 software. It’s worth noting that this solution is actually low-cost, requiring less than 70% CPU usage, less than 2 GB of RAM, and a peak runtime of two minutes. This section elucidates our proposed chatbots/IVR solution's architecture, designed for real-life emergency deployment within the ODIN 112 project. The system distinguishes non-urgent emergency situations from urgent ones to optimize response times. The proposed architecture integrates seamlessly into the ODIN 112 system, activating upon manual authorization by an authorized administrator. It automatically handles calls exceeding the two-minute response threshold by posing standard pre-recorded questions eliciting simple responses. Administrators can configure the percentage distribution between urgent and non-urgent calls. For non-urgent scenarios, callers are redirected without urgent labels and provided with a web form to furnish non-urgent event details [14]. Figure 3 illustrates the architecture and business logic of the chatbots/IVR solution, comprising a multi-layer module for emergency type identification and urgency determination, ensuring all calls are addressed promptly by emergency operators. The proposed lightweight architecture seamlessly integrates into the national emergency system, ensuring uninterrupted service quality and user satisfaction, especially during high-stress emergency situations.

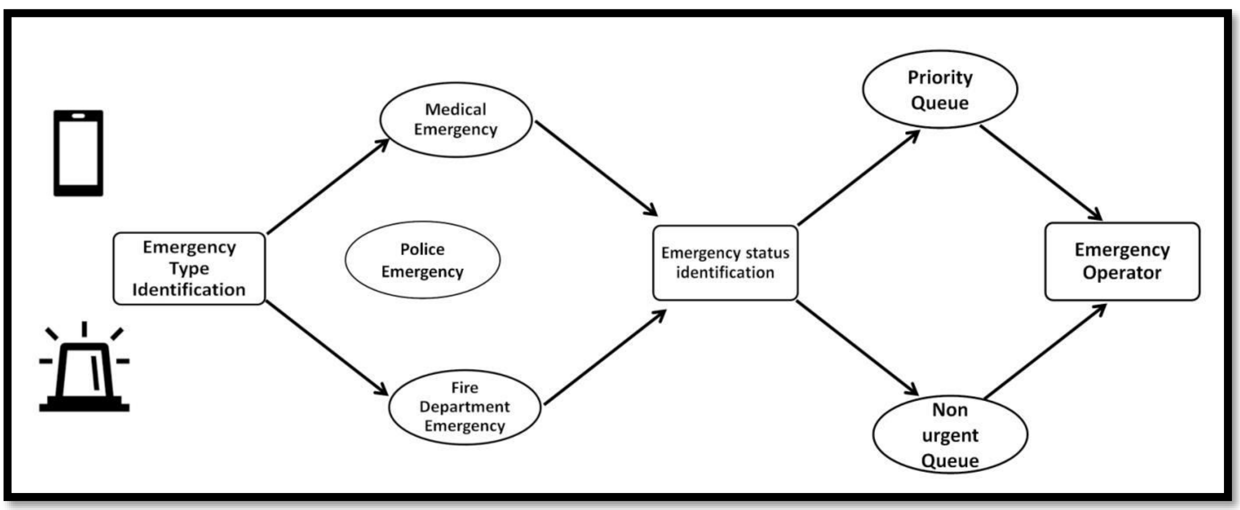

Figure 3: Architecture and Business Logic of Chatbots/IVR Solutions; This figure illustrates the key components and business logic of a chatbot or IVR (Interactive Voice Response) system for emergency services. It shows the flow of information and decision-making process, starting from emergency type identification, triaging different types of emergencies, determining priority, and routing to the appropriate emergency operator or queue.

Web-Based Chatbots and Phone IVR Solution

Chatbots, inherently task-oriented, are adept at handling predefined micro world requests. Tailored for emergency scenarios, our solution delineates micro worlds for police, medical, and fire department emergencies. The Botpress Proof of Concept (PoC) underwent rigorous testing across these use cases, demonstrating successful functionality [21]. The validation process involved manual cross-checked verification of intent and chatbot behaviour against predefined test cases, affirming the platform's viability. In addition to web solutions, telephony-based IVR PoC is designed to use open-source Session Initiation Protocol (SIP) solutions, specifically Free Switch. The solution uses Dual Tone Multi- Frequency (DTMF) techniques to integrate with the prevailing machine of the country wide Emergency reaction device 112. Utilizing fuzzy-logic decision trees, the system adeptly categorizes emergencies into urgent and non-urgent situations, ensuring prompt and efficient call handling. Implemented using the LUA programming language, this PoC embodies simplicity and efficiency, aligning with the project's overarching objectives [4].

Results

Performance Evaluation of PoC

Initial evaluation of this solution includes normal overall performance enhancements based totally mostly on CPU load and memory SLA (Transmitter Level Agreement) compliance. That's why we analysed all the answers on the same device (a regular computer with Intel CPU @ 3.2 GHz, 12 GB RAM and 512 GB SSD). Our first attempt becomes a price-benefit analysis. This takes a look at contains identical quantity of phrases for internet solution and cellular solution. The effects display that the cell phone-based totally pc outperforms the net-primarily based answer, as proven in determines four. The performance evaluation illustrated in Figure 4 provides valuable insights into the resource utilization and scalability of the telephony IVR and web chatbot solutions, which can inform decision-making and optimization efforts for customer service and support systems.

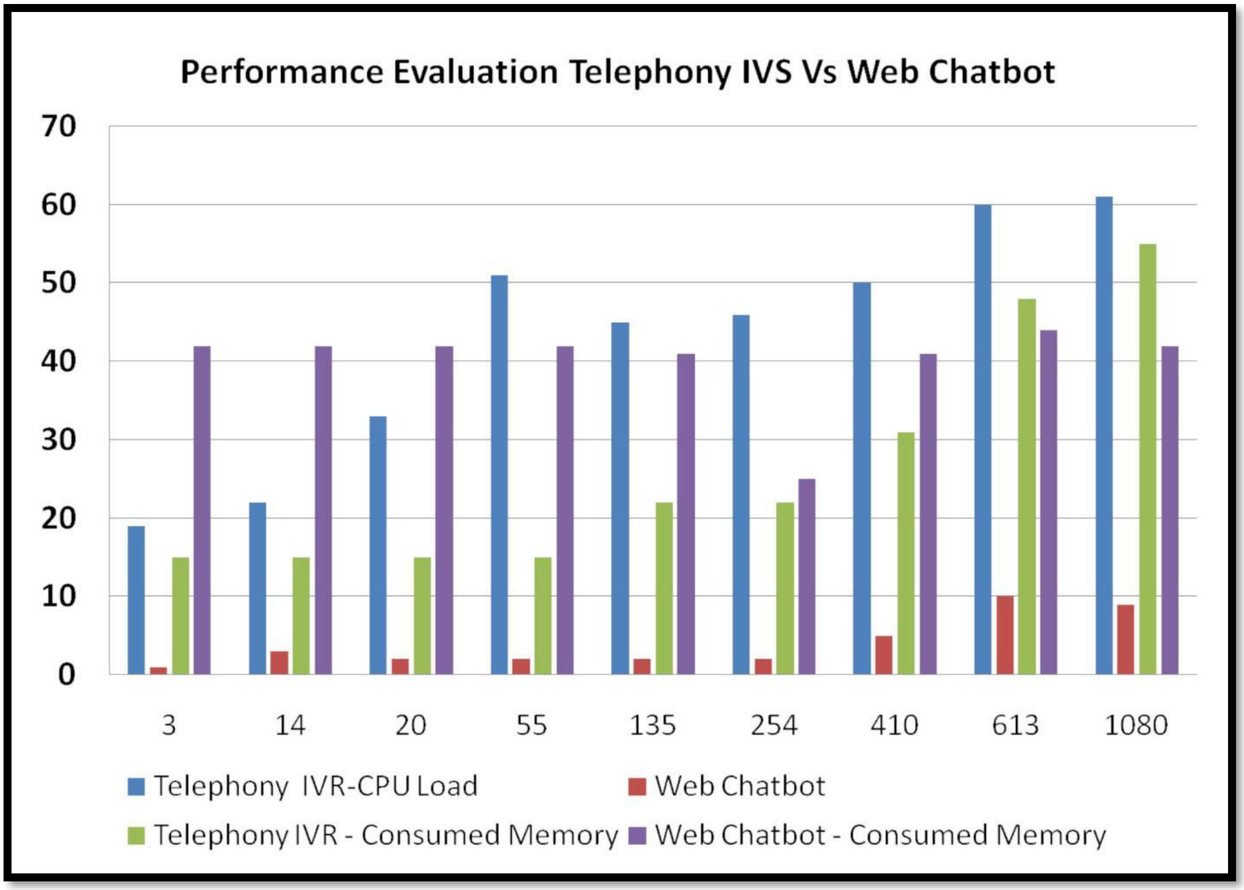

Figure 4: Performance Evaluation of Telephony IVR vs. Web Chatbot; This figure presents a comparative performance evaluation of a telephony IVR (Interactive Voice Response) system and a web chatbot, based on metrics such as CPU load and memory consumption across different call/message volumes. The x-axis represents the number of calls/messages, while the y-axis depicts the CPU load and memory consumption percentages. The data points for the telephony IVR and web chatbot are plotted on the chart, allowing for a visual comparison of their performance characteristics.

Resource Consumption Analysis

The first test involves a resource usage analysis. This test includes an equal number of web solutions and phone solutions. The outcomes display that cell phone-based percent is extra efficient than internet-primarily based answers in terms of aid utilization, as shown in determine five. Although web solutions use modern and effective technologies and are one of the best ways to do this, Emergency in the country is not high-quality as its miles primarily based on a static system that simplest expands sometimes. The information provided in Figure 5 can be used to assess the relative strengths and weaknesses of the telephony IVR and web chatbot solutions, which can inform decisions on optimizing customer experience and improving overall service delivery.

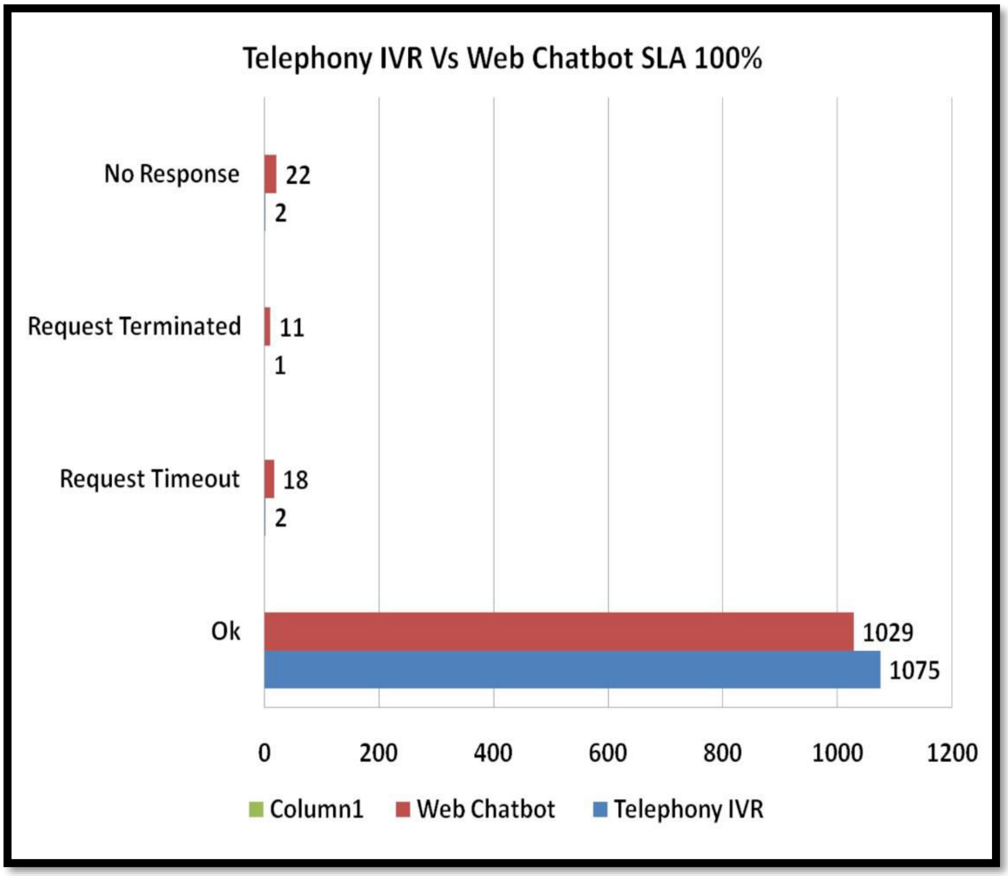

Figure 5: Telephony IVR vs. Web Chatbot Service Level Agreement (SLA) Comparison; This figure presents a side-by-side comparison of the Service Level Agreement (SLA) performance metrics for a telephony IVR (Interactive Voice Response) system and a web chatbot. The metrics shown include "No Response", "Request Terminated", "Request Timeout", and "Ok" (successful requests). The data is displayed in a bar chart format, with the web chatbot metrics represented in red and the telephony IVR metrics in blue. This visual comparison allows for a clear understanding of the differences in SLA performance between the two customer service channels.

SLA Compliance

The second dimension determines compliance with the SLA, which is a one hundred% achievement target and a most of 1500 ms for both answers. The consequences display that both answers carry out properly in phrases of SLA compliance. However typical, the smartphone-based p.c outperforms the internet-based answer by way of 4.26%, as proven in discern five.

Objective: Achieve one hundred% coping with of emergency interactions with a maximum put off of 1500 ms.

Importance: In emergency structures, well timed reaction is essential. Delays could have excessive outcomes, so preserving strict SLA compliance is crucial to make certain every call or message is addressed directly.

Phone IVR vs Web Chatbots SLA

An important metric in evaluating the use of telephone IVR (Interactive Voice Response) and web Chatbots solutions in emergency call handling is SLA (Service Level Agreement) compliance SLA compliance ensures if the system can manage communication all occurrences are processed within the maximum delay specified, with the event being 1500 milliseconds (ms). Here is a description of the comparison between phone IVR and web chatbots solutions in terms of SLA compliance. Telephony IVR and Web Chatbot Solution:

Architecture: The telephony IVR machine makes use of a strong structure designed to handle excessive volumes of calls efficaciously. It operates independently of internet connectivity, making it more dependable in areas with terrible net insurance.

Resource Efficiency: The telephony-based totally solution proven better performance in terms of CPU load and reminiscence usage compared to the net-based totally answer.

SLA Compliance: The telephony IVR solution met the one hundred% SLA compliance requirement with a massive margin, showing higher universal overall performance with a 4.26% increase in managing time as compared to the net-based totally solution. This shows that the IVR system is enormously effective in ensuring well timed responses in the stipulated most postpone.

Architecture: A web-based chatbot uses modern scalable technology designed for dynamic environments. It provides an intuitive way to control user interactions through a web interface.

Scalability: While web-based solutions are inherently more scalable due to cloud-based infrastructure, they are less suited to static environments such as the National Emergency System than periodically scaled static infrastructure depends.

Resource consumption: The web-based solution exhibited high resource consumption compared to telephone IVR, resulting in potential performance issues under high load conditions.

SLA Compliance: Although the web chatbot solution also achieved 100% SLA compliance, it did so inefficiently. The performance was satisfactory but showed a smaller difference compared to telephone IVR, indicating a slightly longer response time.

Discussion: The results of the study reveal significant insights into the efficiency and performance of the proposed solutions for emergency call handling. The telephony IVR solution stands out for its superior resource usage, particularly in environments characterized by static infrastructure and limited internet connectivity (Figure 4). This efficiency is crucial in emergency situations, where reliable performance is paramount. The IVR system demonstrates a consistent ability to maintain functionality without being hindered by bandwidth limitations, ensuring that emergency calls can be processed swiftly and effectively, even in less-than-ideal conditions. On the other hand, the web-based chatbot solution offers distinct advantages in terms of scalability and flexibility. This approach is particularly beneficial for environments that can take advantage of dynamic scaling and robust internet infrastructure. The ability to adapt quickly to varying loads makes the web-based solution an attractive option for organizations that anticipate fluctuating demand. As emergency situations can arise unpredictably, having a scalable solution allows for a more responsive system that can handle increased call volumes without compromising service quality. Despite these differences, both solutions achieved an impressive 100% Service Level Agreement (SLA) compliance, demonstrating their capability to meet essential performance standards. However, the telephony IVR solution validated its superiority with a 4.26% improvement in handling time, reinforcing its reliability as a choice for emergency systems where every millisecond is critical. This enhanced performance underscores the importance of rapid response times in emergency scenarios, where delays can have serious consequences. The comparative analysis of these two approaches highlights their respective strengths and weaknesses, providing valuable insights into their suitability for emergency call handling (Figure 5). The choice between the telephony IVR and web-based chatbot solutions ultimately depends on the specific infrastructure and performance requirements of the environment in which they are deployed. For settings where internet connectivity is a concern, the telephony IVR emerges as the more dependable option. Conversely, in situations where robust internet infrastructure is available, the web-based chatbot can offer greater flexibility and scalability (Table-1). This nuanced understanding of each solution's capabilities will help organizations make informed decisions tailored to their unique operational needs.

Table 1 - Comparison of Metrics between Web-based totally Chatbot and Telephony IVR Solutions

Metrics	Web-based Chatbot	Telephony IVR
CPU Load (%)	Higher	Lower
Memory Consumption (%)	Higher	Lower
SLA Compliance	Satisfactory	Satisfactory
User Satisfaction	Not Evaluated	Future Study
Trust in System	Not Evaluated	Future Study
Complexity of Decision Tree	Lower	Higher
Handling of Emergency Types	Limited	Comprehensive
Depth of Solution	Shallower	Deeper

The table compares various metrics between web-based chatbot phones and IVR solutions:

CPU Load (%): This metric suggests the percentage of CPU utilization through every answer. The web-based totally chatbot usually exhibits higher CPU load in comparison to the telephony IVR due to the computational sources required for processing net-based interactions.

Memory Consumption (%): Memory consumption refers to the quantity of RAM used by every answer. The net-primarily based chatbot tends to have better memory intake compared to the telephony IVR, frequently due to the extra overhead related to internet-based frameworks and interactions.

SLA Compliance: Both solutions achieve satisfactory SLA compliance, i.e. meets the service level agreement in terms of call handling and response This means that both solutions are able to handle emergency calls efficiently within a specified time frame.

User satisfaction: User satisfaction with the solutions has not been assessed in the present study but it is decided to conduct future research. This metric will look at the level of satisfaction of users interacting with each solution and their perceptions of system effectiveness and functionality.

Trust in System: Similar to user pride, agree with in the system is likewise recognized as a future take a look at region. This metric might gauge the level of accept as true with and self-assurance users have in every solution's capacity to address emergency conditions reliably and effectively.

Complexity of Decision Tree: The telephony IVR answer commonly capabilities a greater complex choice tree in comparison to the net-primarily based chatbot. This lets in the telephony IVR to handle a much broader variety of emergency kinds with more granularity and precision.

Handling of Emergency Types: The telephony IVR answer gives comprehensive handling of numerous emergency sorts, whereas the net-based totally chatbot may be restrained in its ability to deal with positive sorts of emergencies due to its design and platform constraints.

Depth of Solution: In phrases of depth, the telephony IVR answer tends to be deeper, which means it can deal with extra complicated eventualities and emergency conditions as compared to the web-based totally chatbot, which might also have a shallower intensity of functionality.

Overall, the table – 1 provides insights into the performance and capabilities of each solution across different metrics, highlighting their respective strengths and areas for further improvement or evaluation.

Building on the insights gained from the study, future work will prioritize the assessment of end-user satisfaction to better understand the real-world impact of the AI chatbot and telephony IVR solutions. A focused research project in a specific geographical area in Romania will evaluate key metrics such as call completion success rates, user confidence in IVR systems, voice quality, and overall acceptance among users. This comprehensive analysis will provide critical insights that are essential for refining the framework and ensuring its effectiveness in practical applications. By gathering user feedback, developers can make informed adjustments that enhance the system's usability and reliability, ultimately leading to improved emergency response outcomes. Moreover, the scope of future initiatives will expand based on the results of pilot projects, aiming to cover larger geographical areas. This expansion will facilitate a deeper understanding of the scalability and adaptability of the solutions across diverse environments. Additionally, integrating the AI chatbot and IVR systems with other emergency services and databases will be explored to enhance coordination and efficiency in emergency responses. Future iterations of the technology may also incorporate advanced features such as multi-language support, improved natural language processing capabilities, and integration with IoT devices for real-time data collection and analysis. Ongoing research and development will focus on addressing the limitations of current language models, enhancing the AI chatbot's functionality and accuracy. As these systems evolve, it will be crucial to prioritize ethical and privacy considerations, ensuring compliance with data protection regulations while maintaining user trust in the technology.

Conclusion

The development and evaluation of AI chatbot solutions for emergency systems, particularly in the ODIN112 project, have demonstrated substantial enhancements in human-computer interaction during critical situations. Two proposed solutions—web-based chatbots and phone-based IVR—were assessed based on resource utilization and quality of service (QoS) metrics. The telephony IVR outperformed the web-based chatbot in resource performance, showing an average of 16% less CPU load and 38.45% better memory usage, making it a more viable option for environments with limited internet connectivity. Both solutions achieved 100% SLA compliance, but the telephony IVR exhibited a 4.26% improvement in handling time, indicating greater reliability and quicker response times essential for emergency systems. Additionally, the telephony IVR provided a more precise and complex decision tree compared to existing systems, allowing it to handle various emergencies with improved accuracy. Real-time testing confirmed the system's capability to manage speech transcription and emotional state recognition during emergency calls, highlighting its practical applicability and robustness. Overall, the advancement of AI chatbots for assisting callers in emergencies marks a significant progression in emergency response systems, meeting immediate needs while paving the way for future innovations in effective emergency management.

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Conflicts of interest

The authors declare no conflicts of interest.

Author Contributions

Ehtesham Ahmed Shariff designed the study, conducted the data analysis, wrote the manuscript, and managed communication. Suriyakala Perumal Chandran planned the study, interpreted the data, and proofread and reviewed the manuscript.

Ethics Approval

This study did not require ethical approval as it did not involve human subjects or sensitive data.

Data Availability

All data has been included in the published manuscript.

Abbreviation

LLMs - Large Language Models; IVR - Interactive Voice Response; QoS - Quality of Service; PoC - Proof of Concept; AI - Artificial Intelligence; IoT - Internet of Things; NLP - Natural Language Processing; CPU - Central Processing Unit; Session Initiation Protocol (SIP); Dual Tone Multi- Frequency (DTMF)

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