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A Survey of Health Care Chatbot for Patient Support

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Abstract: *This literature survey delves into the evolving realm of healthcare chatbots, analyzing a variety of research papers on AI chatbot systems. The papers cover diverse objectives, methodologies, and applications within healthcare, including microservice architectures for chronic patient support, disease prediction, herbal remedies, and mental health support. Common threads across the papers include the adoption of natural language processing, machine learning, and AI markup languages. Ethical considerations, such as data privacy and consent, are identified as crucial aspects. Some papers focus on specific medical domains, while others propose comprehensive frameworks integrating IoT and health knowledge graphs. The survey highlights challenges like unified semantic approaches for patient data and underscores the ongoing need for research to address gaps, enhance chatbot intelligence, and ensure ethical deployment in real-world healthcare scenarios.*

Keywords: healthcare chatbots, AI chatbot systems, literature survey, natural language processing, machine learning, AI markup languages

I. INTRODUCTION

The integration of artificial intelligence (AI) technologies into healthcare has ushered in a new era of innovation, with healthcare chatbots standing out as a significant application. These intelligent conversational agents have the potential to transform patient interactions, providing tailored health information, predicting diseases, and contributing to overall healthcare management. As the field witnesses a surge in research and development, this literature survey aims to offer a comprehensive overview of recent advancements, methodologies, accomplishments, and challenges within the dynamic realm of healthcare chatbots.

Examining a diverse array of research papers, this survey encapsulates various perspectives, from microservice architectures designed for chronic patient support to specialized chatbots offering herbal remedies and predicting diseases. Each paper contributes distinctive insights into the design, implementation, and evaluation of healthcare chatbots, leveraging technologies such as natural language processing, machine learning algorithms, and AI markup languages.

While spotlighting successful endeavors in developing chatbots for specific medical domains, such as cardiology or mental health, the survey also brings attention to areas where objectives may not have been fully realized. Ethical considerations, including data privacy, consent, and liability, emerge as critical aspects that require heightened scrutiny in the deployment of healthcare chatbots.

Beyond domain-specific applications, the survey explores overarching frameworks that integrate the Internet of Things and background health knowledge graphs. This integration aims to provide context-aware and personalized health services, introducing possibilities for more intelligent, engaging, and effective healthcare chatbot solutions.

This literature survey consolidates key findings, identifies common trends, and pinpoints research gaps, offering insights for researchers, developers, and healthcare practitioners actively involved in advancing healthcare chatbots. The overarching goal is to contribute to the ongoing refinement of these technologies, addressing challenges and ensuring their responsible and ethical deployment in real-world healthcare settings.

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II. LITERATURE SURVEY

This literature survey encompasses a thorough examination of 16 research papers focused on the evolving landscape of healthcare chatbots, contributing to the development and implementation of artificial intelligence (AI) chatbot systems. Each paper is meticulously analyzed, addressing diverse objectives, methodologies, and applications within the healthcare domain. The key contributions, achievements, and areas where objectives were not fully realized in each paper are discussed.

The surveyed papers cover innovative approaches, including microservice architectures for chronic patient support, disease prediction using chatbots, AI-based healthcare systems offering herbal remedies, and mental health support chatbots utilizing natural language processing and cognitive therapy. Common themes across the papers include the adoption of natural language processing, machine learning algorithms, and AI markup languages for effective communication between chatbots and users.

Ethical considerations, such as data privacy, consent, and liability, emerge as critical aspects requiring increased attention in the development of healthcare chatbots. The survey also emphasizes challenges such as the lack of unified semantic approaches for patient data integration, ensuring chatbot performance and user satisfaction, and evaluating the long-term effectiveness and ethical implications of healthcare chatbots.

By providing valuable insights into the diverse research efforts in healthcare chatbots, this comprehensive literature survey aims to guide researchers, developers, and healthcare professionals involved in the design, implementation, and improvement of AI chatbots for healthcare applications. It underscores the need for continued research to address existing gaps, enhance chatbot intelligence, and ensure the ethical deployment of these technologies in real-world healthcare scenarios.

Divya S et al. [1] This paper proposes a self-diagnosis chatbot using AI and symptom extraction. Achievements include personalized diagnosis. Limitations involve natural dialogue support and the need for more medical features.

Surya Roca et al. [2], This paper introduces a microservice-based chatbot architecture for chronic patient support, emphasizing scalability, standard data sharing, and conversation modeling. The achievement includes proposing an innovative FHIR-to-AIML automation mechanism for medical data gathering. The architecture proves feasible with a prototype for psoriasis patients, though limitations involve the prototype's proof-of-concept nature and lack of ethical considerations.

Jayashree kanniappan et al. [3] Focusing on disease prediction, this paper presents a healthcare chatbot using AI, text-to-text conversation, and AIML algorithm. The achievements include a user-friendly interface, a chatbot engine, and high accuracy in predicting diseases. However, limitations involve reliance on predefined databases, network issues, and inadequate attention to ethical concerns.

N Jazeem Khan et al. [4], This paper designs an AI-based healthcare chatbot providing herbal remedies and home solutions. Achievements include leveraging NLP, pattern matching, and CSV data for user interaction and comparison with other chatbots. Limitations comprise a lack of user experience evaluation and insufficient discussion on ethical issues in healthcare chatbots.

Seema J et al. [5], Focusing on heart disease prediction, this paper proposes a novel chatbot architecture using Dialogflow and SVM. Achievements involve a prototype demonstrating feasibility, but limitations include the absence of empirical evidence, unclear architecture description, and the lack of ethical considerations.

Batyrkhan Omarov et al. [6], This paper introduces an AI-enabled mobile chatbot psychologist utilizing AIML and CBT. Achievements include a personalized knowledge base and AIML-based engine. Limitations involve the lack of personalization, multimodal capabilities, and real-world effectiveness validation. Collaboration with mental health professionals is suggested.

Vincent Velasco et al.[7], This systematic review explores AI chatbot technology for disease prediction, emphasizing algorithms, data sources, and challenges. Achievements include identifying optimal machine learning algorithms. Limitations involve scope constraints and challenges related to user trust and willingness.

Vanshika Gupta et al.[8], This paper discusses NLP and deep learning in developing a mental health support chatbot. Achievements include user testing success. Limitations involve the absence of long-term effectiveness data, bias considerations, and lack of human oversight clarification.

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Mrs.Rashmi Dharwadkar et al. [9], This paper introduces a medical chatbot using NLP and SVM for disease prediction. Achievements include Google API integration. Limitations involve the need for a large training dataset and neglecting complex queries.

Ruyi Wang et al. [10], Proposing a chatbot for perinatal mental health, this paper uses supervised machine learning. The achievements outline features analysis but lack empirical results. Limitations involve a focus on a subset of mental health issues and neglect of mother-child relationship aspects.

Rayn Matthew et al. [11], This paper develops a medical chatbot using SVM and NLP. Achievements include a comprehensive literature review and algorithm comparison. Limitations involve limited symptom coverage and suggestions for broader inclusion.

Menal Dahiya In [12], Describing a chatbot system, this paper uses Java and pattern matching. Achievements include simplicity and customizability. Limitations involve not addressing ethical and legal concerns.

Shifa Ghare et al. [13], This paper proposes a personalized medical assistant but lacks data validation and detailed diagnosis scope. Limitations involve reliance on training data and the absence of ethical discussions.

III. OVERVIEW OF SYSTEM ARCHITECTURE

Front End (User Interaction):

- Dialogflow or Similar Frameworks: Used for creating conversational interfaces, understanding user inputs, and managing the conversation flow.
- Signal Messaging Platform: Facilitates real-time communication between the user and the chatbot.

Processing and Analysis:

- Natural Language Processing (NLP):Utilized for understanding and interpreting user queries.
- Named Entity Recognition (NER) for extracting relevant information (symptoms, diseases).

Machine Learning Algorithms:

- Support Vector Machine (SVM): Used for heart disease prediction and analysis.
- Artificial Neural Network (ANN): Applied for question classification and response generation.

Data Storage and Retrieval:

- FHIR Standard: Facilitates standard data sharing for healthcare information.
- XML Database: Used for medical data storage.
- Health Knowledge Graphs (HKG) and Patient Health Knowledge Graphs (PHKG): Employed for contextualized and personalized health services.

Integration and Automation:

- Microservices Architecture: Ensures scalability and modularity for chronic patient support.
- Web API: Connects the chatbot engine to relevant services or databases.
- AIML (Artificial Intelligence Markup Language): Utilized for chatbot design and conversation scripting.

Prediction and Decision Making:

- Pattern Matching and Category Classification: Employed for symptom detection.
- Score Assignment and Sorting Algorithms: Used for disease prediction.

Implementation and User Interaction:

- Python Programming Language: Utilized for developing the chatbot system.
- Online APIs: Integrated for various functionalities such as medical assistance and voice-text conversion.
- Applets and Pattern Matching Techniques: Employed in Java-based chatbot implementations.

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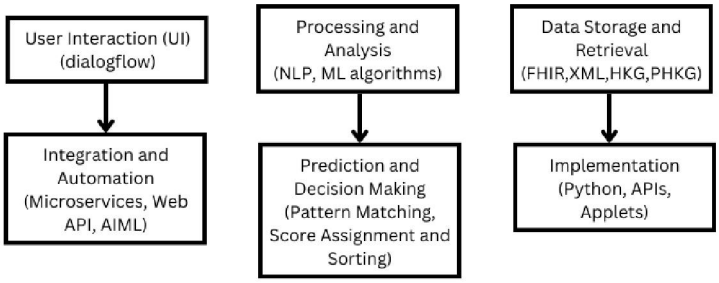

Fig. 1 Common Architecture for Healthcare Chatbot

This block diagram illustrates the interconnected components of a healthcare chatbot system based on the common architecture. The various elements work together to provide a seamless and efficient healthcare chatbot experience, incorporating NLP, ML, and standardized data sharing models.

IV. CHALLENGES

Developing a healthcare chatbot presents several challenges that need to be addressed to ensure the effectiveness, accuracy, and ethical considerations of the system. Here are some challenges associated with healthcare chatbot projects:

- Data Security and Privacy: Ensuring the confidentiality and security of sensitive health data is a critical concern. Compliance with data protection regulations, such as HIPAA, poses a challenge in designing robust security measures.
- Accuracy and Reliability:Achieving high accuracy in disease prediction and medical advice is challenging due to the complexity of healthcare data and the need for up-to-date medical knowledge. Inaccuracies can lead to incorrect diagnoses and recommendations.
- Interoperability with Existing Systems:Integrating the chatbot with existing healthcare systems, Electronic Health Records (EHR), and other medical databases poses a challenge due to diverse data formats and standards.
- User Trust and Ethical Concerns:Gaining and maintaining user trust in the chatbot's capabilities and ethical use of health information is crucial. Users may be skeptical about relying on a machine for medical advice.
- Handling Ambiguity in User Queries: Healthcare-related queries often contain ambiguous or complex language. Developing NLP models that can accurately interpret and respond to ambiguous user queries is a challenging aspect.
- Continuous Learning and Updating: Keeping the chatbot updated with the latest medical knowledge and ensuring continuous learning from new research findings is a persistent challenge in the dynamic field of healthcare.
- Legal and Regulatory Compliance: Adhering to various legal and regulatory frameworks in different regions can be complex. Navigating through compliance requirements related to healthcare standards and regulations is crucial.
- Cultural Sensitivity and Diversity: Healthcare is influenced by cultural factors and varies across diverse populations. Ensuring that the chatbot is culturally sensitive and provides relevant information to users from different backgrounds is a challenge.
- Emergency Situations and Liability: Handling emergency medical situations and understanding the liability of the chatbot in critical scenarios is a complex issue. Ensuring the chatbot doesn’t provide inappropriate or delayed responses is crucial.
- Integration with Real-Time Data: Integrating real-time data, such as wearable device information or IoT devices, to provide personalized health services poses challenges related to data synchronization and accuracy.

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V. CONCLUSION

This literature survey explores a range of healthcare chatbot architectures, highlighting their applications in diverse domains. From microservices for chronic conditions to specialized predictors, these designs leverage technologies like AIML and NLP. While showcasing versatility, notable limitations include a lack of comprehensive evaluation and oversight of ethical considerations.

The need for improvement is evident, with some papers introducing innovative features while others fall short in addressing user satisfaction and broader mental health issues. In summary, the surveyed papers present a dynamic landscape of healthcare chatbots, demonstrating their potential to revolutionize patient support. However, a unified approach, rigorous evaluation, and heightened ethical considerations are crucial for successful integration into mainstream healthcare. Future research should focus on bridging these gaps to ensure both technical excellence and user-centric adherence to ethical and legal principles.

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