Master Research Proposal Nr:

Topic: Context-Aware AI Chatbot for Breast Cancer Prevention: A Study on Accuracy and User Acceptance

Breast cancer is the most common cancer among women globally, with 2.3 million new cases in 2022. In Germany, about 74,500 new cases are diagnosed annually, with one in eight women developing breast cancer in their lifetime [1][2]. While mammography screening has contributed to reducing late-stage cancer mortality, challenges remain due to a lack of awareness and inadequate access to prevention information [3]. Research shows that adherence to prevention guidelines significantly reduces breast cancer risk, emphasizing the need for accessible, evidence-based public health resources to educate the public and promote early detection [4].

The rise of large language model (LLM)-powered chatbots, such as ChatGPT, presents an opportunity to bridge this informational gap. Unlike traditional rule-based chatbot, ChatGPT can deliver dynamic and human-like interactions, making it the preferred option for health-related queries [5]. However, they still face challenges including hallucinations, inaccuracies, privacy risks, and reliance on medical guidelines, limiting their reliability for cancer-related communication [6][7]. Also, the integration of personalized health information tailored to individual need is crucial to improve accessibility, accuracy, and user-engagement [8][9]

To address these limitations, adapting LLMs for domain-specific applications typically requires fine-tuning with specialized data, a process that is computationally expensive, time-consuming, and impractical [10]. As an alternative, this project will utilize Retrieval-Augmented Generation (RAG), which dynamically retrieves information from external databases during generation, enriching outputs with breast cancer specific knowledge without the need for retraining. [10][11]

As part of digiOnko project, the aim of this thesis is to develop a Chatbot for personalized information on preventive behaviors. This Chatbot is designed to support women early breast cancer prevention and education by providing accurate and accessible information on preventive measures, recommended screenings, risk factors, and general breast health, empowering users with tailored health information.

The research question that should be answered during this thesis are:

- How does the developed RAG-based chatbot compare to state-of-the-art AI chatbot, such as ChatGPT, in generating accurate and relevant responses specifically for breast cancer prevention based on trusted German guidelines?
- How do users evaluate the usability, trustworthiness, and overall acceptance of the RAG-based chatbot in delivering personalized breast cancer prevention information?

In the light of this objective, this work consists of the following parts:

- Comprehensive literature review on the topics: Evaluation metrics on accuracy and acceptance of AI-generated medical content, suitable RAG-Framework and LLM Model, Breast Cancer Prevention and Education, Ethics in AI, Chatbot Development.
- Construction of Knowledge Base Regarding Breast Cancer Care in Germany.
- Design and develop an interactive Chatbot utilizing the selected RAG-Framework. This Chatbot should be user-friendly and able to generate general information as well as personalized health information regarding breast cancer prevention in accordance with guidelines and state-of-the-art practices in Germany.

- Conduct a study involving at least three experts to evaluate the response accuracy, completeness and relevance compared to state-of-the-art AI chatbots.
- Conduct a user study with at least ten female participants to evaluate the usability, trustworthiness, and overall acceptance.

The thesis must contain a detailed description of all developed and used algorithms as well as a profound result evaluation and discussion. The implemented code has to be documented and provided. An extended research on literature, existing patents and related work in the corresponding areas has to be performed.

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