EDITORIAL

NuMeVChat: A Conceptual AI-Driven Visual Chatbot for Advancing Personalized Cancer Care in Nuclear Medicine

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As medical physicists specializing in Nuclear Medicine (NM) imaging, we strongly believe that innovative AI technologies will shape the future of medical image analysis and revolutionize personalized cancer care in nuclear medicine. This letter explores the potential of integrating the strength of conversational generative pre-trained transformer (ChatGBT) and Visual Question Answering (VQA) toward more accurate and tailored patient management strategies. While the visual chatbot system presented in this paper, NuMeVChat (an acronym for nuclear medicine vision chat), is a purely hypothetical concept at this stage, we like to envision a future direction where it provides valuable insights and information in real-time and revolutionizes the way medical professionals interact with NM imaging data.

The ChatGBT model currently assists medical physicists in providing medical information, automating tasks, and collaborating with other professionals. However, its limitations in processing images may limit its effectiveness. Despite the introduction of visual chat models such as the VQA, it is important to acknowledge that these models have inherent limitations. As such, the limited dataset of images for training and evaluation impacts the overall accuracy and comprehensiveness of the VQA model in processing and generating images.

It is crucial to consider the limitation when comparing the performance of the VQA model to the ChatGBT model, which may have access to a more extensive dataset for training and refining its capabilities. The NuMeVChat model comes to the rescue here, thanks to its advanced image processing and analysis capabilities as well as access to extensive datasets in the field of NM.

NuMeVChat is a conversational AI technology that leverages cutting-edge computer vision techniques to analyze and interpret NM images and Natural Language Processing (NLP) to communicate the results to users through a chat interface. NuMeVChat system would seamlessly analyze and interpret NM images and dialogues and generate comprehensive answers to user questions. In this regard, a Convolutional Neural Network (CNN) would be appropriate for analyzing and interpreting NM images by training on a diverse and extensive dataset of NM images. Meanwhile, the NLP module employs a transformer-based neural network architecture to understand, generate, and interpret natural language. Through the use of a transformer model trained on a large dataset of NM dialogues, the NLP module can analyze and interpret user questions with great accuracy. In addition, the system can generate appropriate responses based on the analysis of NM images and the user's intent.

A schematic representation of the proposed NuMeVChat model is shown in Figure 1. The figure illustrates how the visual chatbot system can provide valuable insights and information to healthcare professionals by leveraging computer vision and NLP technologies. With NuMeVChat, CNN and transformer are combined to efficiently extract features from images and establish long-range dependencies between input images and dialogue chat.

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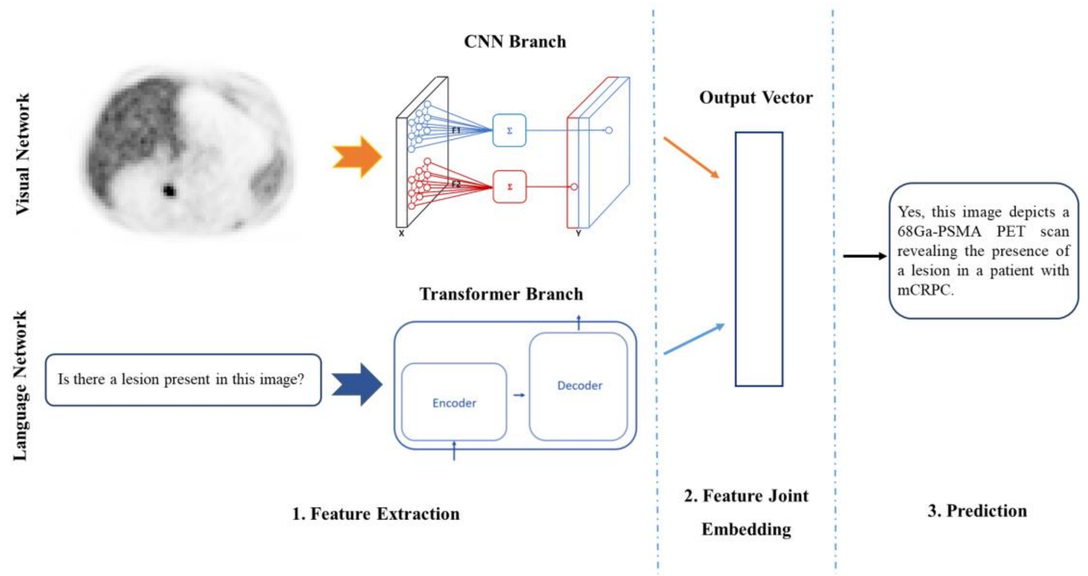

Figure 1. Schematic representation of the NuMeVChat model for NM image analysis. Using CNN and Transformer-based architectures, the model enhances the accuracy and efficiency of medical image analysis

NuMeVChat can accurately complete a wide range of tasks such as identifying and segmenting different structures within an image. It also has the potential to extract quantitative information and provide more detailed and accurate insights into disease and patient outcomes. It could also greatly improve radiation safety by predicting and calculating radiation exposure during radionuclide therapy. The NuMeVChat model will significantly enhance NM diagnostics, procedures, and treatments. Thus, we can improve patient outcomes and better understand the disease.

To demonstrate the potential of the NuMeVChat model in practice, Figure 2 illustrates how it can be used to answer cancer treatment questions. For example, the model can analyze NM images and understand the context provided by text input. In addition, the model can segment Organs At Risk (OAR) and lesions, extract features, predict the most suitable treatment for the patient, and predict the amount of radiation dose that OARs and lesions will receive. It can generate relevant responses or perform specific tasks based on the input.

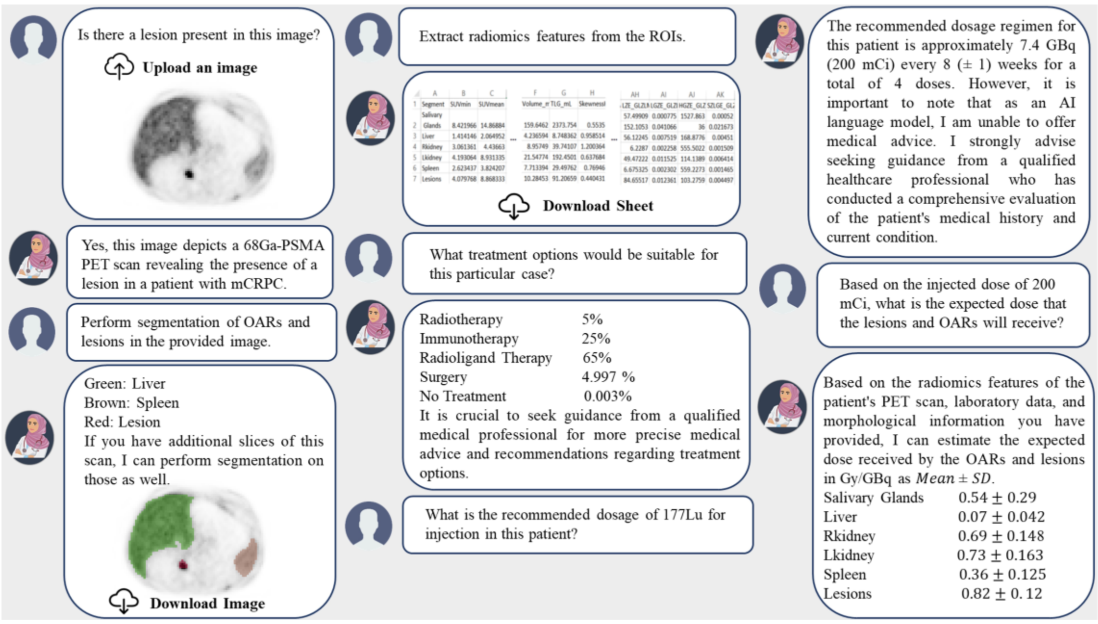

Figure 2. An example of the interactions by the proposed AI model. Based on the input, the NuMeV analyzes NM (PET) image, understands the context provided by the text input, and generates relevant responses

Despite the potential benefits of AI technologies, there are some limitations. Before this technology can be developed and widely adopted in clinical practice, concerns regarding data privacy and the need for further validation studies must be addressed. Developing such a model would also require a large amount of data and computational resources. Furthermore, computer vision and natural language processing expertise would be required. Nuclear medicine will likely experience ongoing innovation and the emergence of state-of-the-art technologies and techniques as it evolves. NuMeVChat saves time and improves diagnoses and treatment plans by automating time-consuming tasks. It can be used in a variety of healthcare settings, including radiology departments, hospitals, and clinics. Thus, it can potentially advance our understanding of the disease and inspire and guide future research in personalized cancer care.

As a final note, fellow researchers and medical professionals are encouraged to embrace the utilization of advanced AI technologies and collaborate to unlock their full potential. By leveraging innovative AI technologies, the field of cancer care has the potential to undergo a paradigm shift, and advancements can be made toward more accurate and tailored patient management strategies. Doing so can pave the way for a future in cancer care characterized by enhanced precision, efficiency, and effectiveness.