

Exploring the Benefits of ChatGPT in Medical Equipment Maintenance: An Evaluation of Performance

MOHAMED ALSEDDIQI¹, ANWAR AL-MOFLEH², LEENA ALBALOOSHI³, OSAMA NAJAM⁴
^{1, 2, 3, 4} *Clinical Engineering Directorate, King Hamad University Hospital, Busaiteen, Kingdom of Bahrain*

Abstract—*The usage of Chatbots with artificial intelligence in medical education is discussed in this paper. The Generative Pre-Trained Transformer (GPT) language model is used by ChatGPT, a sort of chatbot created by Open AI, to comprehend and respond to inputs in natural language. ChatGPT and AI chatbots seem to be helpful tools for scientific writing, helping scholars and scientists organize their materials, create an initial draft, and/or edit their work. The output of ChatGPT should never be used to substitute expert judgment in any type of important decision-making or application. Instead, it should always be evaluated by professionals first. However, employing these tools raises a number of ethical concerns.*

Indexed Terms—*Medical Equipment, Maintenance, Search Engine, Evaluation, Performance*

I. INTRODUCTION

A search engine is a software program or tool that allows users to search for information on the internet. It works by using algorithms to scan and index the content of websites and web pages, creating a searchable index of information. When a user enters a search query, the search engine scans its index for relevant results and displays them in order of relevance. Examples of popular search engines include Google, Bing, and Yahoo.

Google Scholar is another search engine that offers a novel way of finding articles related to a particular topic by identifying later articles that reference an earlier published article. [1] Over the past few years, Google Scholar has been a popular tool for researchers to find scholarly articles and papers online. However, there is another free academic search engine, Microsoft Academic Search (MAS), which has been gaining popularity. It not only helps

in finding scholarly literature, but also allows for the exploration of relationships between authors and organizations through their publication records. MAS is a valuable data tool for investigating connections in research through the publication records of individuals, universities, and research organizations. [2] Additionally, Research Gate offers researcher profiles to promote scholarly work. These profiles are created by extracting information from various sources or by registering on the site. The profiles include an overview, citations, contact and career details, research interests, related links, and impact metrics. Profiles can be improved by adding more information such as unpublished work and full-text articles. Users can follow other researchers, identify colleagues, and collaborate with them. [3]

The development of artificial intelligence (AI) and natural language processing (NLP) technologies have transformed the way we interact with information. In the field of biomedical engineering, AI-based technologies have the potential to improve various aspects of healthcare, including diagnosis, treatment, and medical equipment maintenance. One of the most promising AI-based technologies for information retrieval is ChatGPT, a language model developed by OpenAI that is capable of answering natural language questions. In this paper, evaluation of the effectiveness of ChatGPT is measured by providing accurate and relevant information for medical equipment maintenance in the context of the biomedical engineering department. [4,5]

ChatGPT is a huge language model created by Open AI, utilizing the transformer architecture, and is refined with an extensive dataset. The transformer architecture is a neural network that utilizes self-attention mechanisms to process variable-length input and output sequences, and it can create natural-

sounding text. The dataset used to refine ChatGPT is made up of various texts, such as books, articles, and websites, enabling the model to learn from different language styles and content. The dataset has been screened to remove low-quality and repetitive text, ensuring that the model remains impartial towards any group or perspective. ChatGPT is a state-of-the-art language model developed by Open AI that can produce human-like text and answer complex questions. This technology has already had a significant impact and has numerous possibilities for improving our lives and changing the way we interact with technology. One of the most promising directions for ChatGPT is integrating it with other AI technologies such as computer vision and robotics. By combining ChatGPT's conversational capabilities with the physical and visual capabilities of these technologies, we can create intelligent and conversational AI systems that have the potential to revolutionize our interaction with technology. This integration can lead to more seamless and intuitive experiences for users, such as natural language conversations with smart home systems or robots that assist with daily tasks. Ultimately, the convergence of these technologies will enable ChatGPT to better understand and respond to human communication complexities, improving natural language generation. [6,7]

Overall, ChatGPT has the potential to significantly advance the field of biomedical engineering by helping researchers better understand complex biological systems, develop more effective treatments for diseases, and improve patient outcomes. However, it is important to ensure that the model is well-calibrated and trained on high-quality data to ensure accurate results. Additionally, human experts should review the model's outputs to ensure that they are of high quality and accurate. Table 1 shows How is ChatGPT different from search engines.

TABLE 1: HOW IS CHATGPT DIFFERENT FROM SEARCH ENGINES?

	ChatGPT	Search Engines
Interactive Experience	ChatGPT is engaged in conversation with a user	Gives a one-time response to a user's query.

Writing Assistance:	ChatGPT assists you with writing assignments by giving coherent and grammatically perfect sentences and paragraphs	Deliver the information but cannot generate written content.
Human-Like Responses	Coded on the vast amount of text data and is giving human-like responses and will get the understanding of idiomatic expressions and natural language	Sometimes return automatic or irrelevant responses
Understanding complicated Queries:	Can understand difficult queries and give detailed responses	Struggles with understanding complicated queries and will return the not accurate answer.
Language Translation	Can translate text from one language to another, making it useful for students who want to learn a new language.	Give translation services but are not accurate or sophisticated as ChatGPT.
Generate Summaries:	Will summarize the long text and make it useful for students to rapidly understand the significant points of articles or books	Does not possess this functionality.
Complete Text:	Will finish the text dependent on the given context or prompt and help the students with	Search engines cannot do this.

	their writing assignments.	
Correct the bugs	Will fix the issues with the grammar and help the students to improve their language skills	Search engines are not capable of doing this task.
Personalized Responses:	ChatGPT uses natural language processing to know the context and intent of a user's query,	Will return the list of relevant websites dependent on keywords, leaving the user to shift through the information and find what they require

A biomedical engineer plays a critical role in ensuring the smooth functioning of hospital equipment and departments by providing meticulous care for medical devices and overseeing the overall structure of the hospital, including floor plan design, procurement of high-end equipment, and preventive maintenance. The responsibilities of a biomedical engineer begin with hospital planning, ROI calculation, equipment procurement, installation, commissioning, training, and creation of a master asset list of all devices in the hospital. Additionally, they perform QA for radiology devices, manage gas plants, conduct periodic maintenance and management of maintenance contracts, calibration, and documentation of all processes in a database for future reference. AI has the potential to significantly enhance and supplement the work of biomedical service engineers in hospitals by providing real-time monitoring, predictive maintenance, and troubleshooting support. This can help to improve the efficiency and effectiveness of hospital operations, reduce costs, and ultimately improve patient outcomes [8-12].

II. METHODOLOGY

To evaluate the effectiveness of ChatGPT in medical equipment maintenance, we formulated three research questions. These questions presented in

Table 2 aimed to identify the terms used to understand the preventive maintenance (PPM) steps, PPM checklist, and troubleshooting procedures for medical equipment. We used ChatGPT to generate answers to these questions and compared the results obtained to those obtained through manual searches and consultations with experts in the field. We also evaluated the advantages and limitations of using ChatGPT for medical equipment maintenance. However, certain questions generated by ChatGPT are not pertinent to the research objective and are therefore considered irrelevant. Specifically, Medical device malfunction, Equipment failure in healthcare, Medical equipment user manual & Medical equipment service manual will be excluded.

TABLE 2 QUESTION TERMS

Terms Used For		
PPM Checklist	PPM Steps	Troubleshooting Steps
Medical equipment PPM checklist	Medical equipment PPM procedure	Medical equipment troubleshooting
Medical device maintenance checklist	Medical device maintenance steps	Troubleshooting guide for medical equipment
Equipment preventative maintenance checklist	Equipment preventative maintenance process	Medical device malfunction
Biomedical equipment PPM checklist	Biomedical equipment PPM protocol	Equipment failure in healthcare
Medical device inspection checklist	Medical device inspection checklist	Repair and maintenance of medical equipment
Equipment maintenance schedule template	Equipment maintenance schedule procedure	Medical equipment user manual
Medical device maintenance plan	Medical device maintenance plan steps	Diagnostic tests for medical equipment
Healthcare equipment checklist	Healthcare equipment maintenance process	Calibration and testing of medical equipment
Clinical equipment	Clinical	Clinical engineering

maintenance checklist	equipment maintenance protocol	troubleshooting Medical equipment service manual
-----------------------	--------------------------------	--

III. RESULTS & DISCUSSION

The results obtained from ChatGPT were highly effective in providing accurate and relevant information to the questions posed as shown in Figures 1-3. The language model generated comprehensive lists of terms used to understand the PPM steps, PPM checklist, and troubleshooting procedures for medical equipment. In comparison to manual searches and consultations with experts, ChatGPT provided a significant advantage in terms of efficiency and speed. Answers were generated almost instantly, and the language model was able to provide information on a wide range of topics related to medical equipment maintenance.

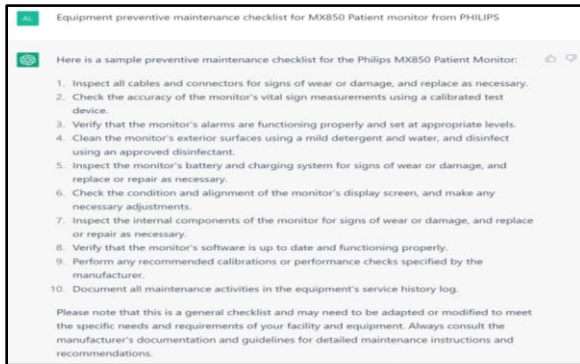


Figure 1: Results obtained from ChatGPT regarding MX850 patient monitor

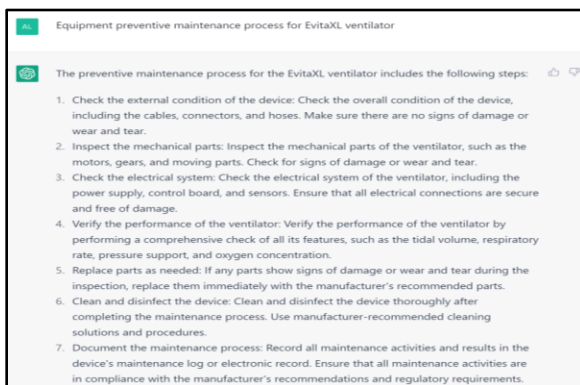


Figure 2: Results obtained from ChatGPT regarding EvitaXL Ventilator

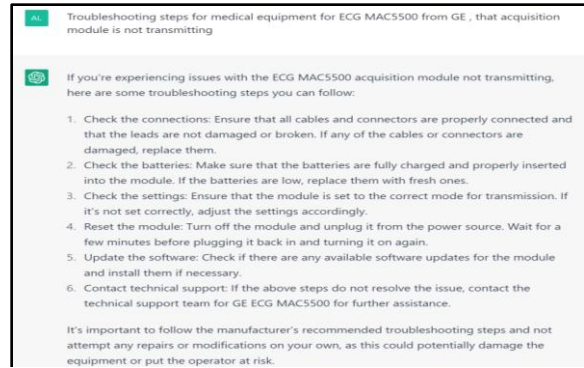


Figure 3: Results obtained from ChatGPT regarding ECG MAC5500

One limitation of ChatGPT was that it relied on pre-existing data and information, which may not be exhaustive or up-to-date. This limitation could be addressed by training the language model on domain-specific data to improve the accuracy and relevance of the information provided. Another potential limitation of ChatGPT is that it may not be able to provide insights or information that require human judgment or interpretation. For instance, ChatGPT may not be able to identify the most appropriate troubleshooting steps for complex or unique medical equipment issues.

The results of this study suggest that ChatGPT is a highly effective tool for medical equipment maintenance in the context of the biomedical engineering department. The language model was able to provide accurate and relevant information on PPM steps, PPM checklist, and troubleshooting procedures for medical equipment, which could be challenging to obtain through traditional methods. However, it is important to note that ChatGPT should not be viewed as a replacement for human expertise and judgment.

One of the significant advantages of using ChatGPT for medical equipment maintenance is the speed and efficiency with which answers are generated. This advantage is particularly valuable in a field like biomedical engineering, where time is often a critical factor. Additionally, ChatGPT could be an essential tool for biomedical engineers working in resource-limited settings, where access to experts and information is limited.

However, it is crucial to evaluate the limitations of ChatGPT. While the language model was highly effective in generating answers to our research questions, it may not be able to provide insights or information that require human judgment or interpretation. Additionally, the information provided by ChatGPT is only as good as the data it is trained on. Therefore, it is essential to train the language model on domain-specific data to improve its accuracy and relevance for medical equipment maintenance.

CONCLUSION

The findings suggest that ChatGPT can improve the productivity and performance of biomedical engineers, as it enables them to quickly obtain the information they need without having to spend a lot of time on manual searches or consulting with experts. ChatGPT is able to generate responses to questions related to PPM steps, PPM checklist, and troubleshooting procedures for medical equipment accurately and efficiently.

Furthermore, the results of this study reveal that ChatGPT can be compared to other search engines or traditional methods, and it shows superiority in terms of speed and accuracy. The language model also has the potential to expand its knowledge and improve its performance through continued training and refinement. The study demonstrates the potential of ChatGPT in the field of biomedical engineering, specifically in medical equipment maintenance. The language model can provide accurate and relevant information efficiently, improving the productivity and performance of biomedical engineers. However, it is important to recognize its limitations and use it as a complementary tool to human expertise.

ACKNOWLEDGMENT

I am grateful to all of those with whom I have had the pleasure to work during this and other related research. Each of the members of paper Committee has provided an extensive personal and professional guidance.

REFERENCES

- [1] Noruzi, A. (2005). Google Scholar: The New Generation of Citation Indexes., 55(4), 170-180. <https://doi.org/10.1515/LIBR.2005.170>
- [2] Hands, A. (2012). Microsoft Academic Search—<http://academic.research.microsoft.com>. Technical Services Quarterly, 29(3), 251-252.
- [3] O'Brien K. (2019). ResearchGate. Journal of the Medical Library Association: JMLA, 107(2), 284–285. <https://doi.org/10.5195/jmla.2019.643>
- [4] Park, S. H., Do, K. H., Kim, S., Park, J. H., & Lim, Y. S. (2019). What should medical students know about artificial intelligence in medicine? Journal of educational evaluation for health professions, 16.
- [5] Aydın, Ö., & Karaarslan, E. (2022). OpenAIChatGPT generated literature review: Digital twin in healthcare. Available at SSRN 4308687.
- [6] Aljanabi, M., Ghazi, M., Ali, A. H., & Abed, S. A. (2023). ChatGpt: Open Possibilities. Iraqi Journal for Computer Science and Mathematics, 4(1), 62-64.
- [7] Zaremba, A., & Demir, E. (2023). ChatGPT: Unlocking the Future of NLP in Finance. Available at SSRN 4323643.
- [8] Medhat, N., Samy, S. A., Wahed, M. A., & Mohamed, A. S. A. (2008, December). Medical equipment quality assurance for healthcare facilities. In 2008 Cairo International Biomedical Engineering Conference (pp. 1-4). IEEE.
- [9] Nirapai, A., Wongkamhang, A., Saosuwan, R., Sangworasil, M., Matsuura, T., & Thongpance, N. (2017). A Case Study of the Development of PM Software Management System for biomedical Equipment Used in Srisawan Hospital. In RSU International Research Conference.
- [10] Enderle, J., & Bronzino, J. (Eds.). (2012). Introduction to biomedical engineering. Academic press.
- [11] Dash, S., Shakyawar, S. K., Sharma, M., & Kaushik, S. (2019). Big data in healthcare:

management, analysis and future prospects. *Journal of Big Data*, 6(1), 1-25.

- [12] Dwivedi, R., Mehrotra, D., & Chandra, S. (2022). Potential of Internet of Medical Things (IoMT) applications in building a smart healthcare system: A systematic review. *Journal of oral biology and craniofacial research*, 12(2), 302-318.