Implementation of generative pretrained transformer (GPT) models in industrial practice and production process

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Abstract: This paper provides an insight into the application of generative pretrained transformer (GPT) models, such as GPT-4 developed by OpenAI, in the field of industrial practice and manufacturing process. The article describes the capabilities of these models, such as natural language understanding and generation, and their role in automating and personalizing services directly in manufacturing industry practice. The work presents concrete examples of how GPT models help automate production processes, support the development of new types of software and services, and facilitate work with artificial intelligence in the fields of robotics and machine control. The article also discusses possible challenges and ethical issues related to the use of these models. It also includes a discussion of the future development and potential of these technologies.

1 Introduction

The first GPT model was released in June 2018, and since then OpenAI has gradually released more powerful models, including GPT-2, GPT-3, and the latest GPT-4 model. These models are general language models that have been trained to understand, generate and respond to natural language through deep learning and a massive training set containing millions of web pages. They are used in a wide range of applications, from content creation to conversational assistants. Generative pre-trained transformers (GPTs) like GPT-4, created by OpenAI , are one of the latest advances in artificial intelligence and machine learning. These models use powerful natural language generation algorithms, allowing text to be automatically generated based on information or instructions provided. They can be trained on a number of different tasks, allowing them to be used in a variety of fields, including education, manufacturing, and software development [1]. One important aspect of GPT models is their ability to understand the context given to them and generate accurate and relevant responses based on it. This can have a major impact on the way we interact with

technology and bring new possibilities for automation and personalization of services. From the point of view of creating program codes, it can significantly reduce the demands on the user [2]. GPT models also have great potential in manufacturing and industry. Thanks to their ability to understand natural language and generate detailed and precise instructions, they can be used to automate production processes and make work more efficient in industry. In addition, models such as GPT-4 can be used to develop new types of software and services, which can bring new opportunities for technology innovation [3]. However, GPT-4, like its predecessors, is not without its challenges. Their use requires a large amount of computing resources, and their results, although often accurate and relevant, are not always perfect. There are also questions regarding the ethics and safety of using such models, especially regarding their ability to generate content that may be misleading or inaccurate [4]. The aim of the following text is to provide an overview of this new field of artificial intelligence, as well as to point out the potential that these technologies offer from the point of view of industry, using concrete examples of real involvement.

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2 Literature review

In the context of the manufacturing industry, the integration of Generative Pre-trained Transformer 4 (GPT-4) and other generative AI models such as ChatGPT presents a landscape filled with opportunities, challenges, and considerations. These advanced AI tools are heralded for their potential to revolutionize industry practices by enhancing automation, improving quality control, optimizing supply chains, and fostering innovation in product design and development. GPT-4, with its advanced deep learning capabilities, is particularly promising for automating complex workflows, thus increasing the efficiency of manufacturing processes. It can undertake tasks like generating production schedules, preparing reports, and analyzing production data, leading to higher productivity levels and significant cost reductions. Moreover, its role in quality control and predictive maintenance is invaluable, enabling manufacturers to proactively address potential issues and enhance product reliability [5]. However, the application of ChatGPT and similar AI technologies in manufacturing isn't without challenges. The risk of generating inaccurate or "hallucinated" information, where models produce outputs not grounded in their training data, poses significant risks, especially where physical damage or injury could occur. Hence, a cautious and incremental deployment strategy is recommended, starting with automating repetitive tasks such as material data management and reporting, to mitigate these risks and realize the benefits of generative AI [6]. Despite the potential, some experts argue that the current iteration of ChatGPT may not be a game-changer for manufacturing execution systems, particularly due to the need for real-time data on the constantly changing shop floor and the vertical, context-specific knowledge required in manufacturing environments. The horizontal knowledge base of ChatGPT might not align well with the nuanced, factory-specific information that drives manufacturing operations [7]. In summary, while GPT-4 and ChatGPT offer promising avenues for innovation and efficiency in the manufacturing industry, their implementation must be approached with caution, focusing on incremental integration and addressing the challenges of data accuracy, privacy, and the need for context-specific knowledge. Balancing these factors will be crucial for manufacturers aiming to leverage AI technologies to gain a competitive edge while ensuring safety, reliability, and ethical use of AI.

3 GPT models

GPT models can also bring significant benefits to industry and manufacturing, especially in the context of industrial automation and robotics. Thanks to their ability to interpret natural language and transform it into specific actions, these models can help automate various manufacturing processes, leading to more efficient production and lower costs. One example is Groundlight, which has developed a platform based on the GPT model that allows programmers, regardless of their coding experience, to understand images programmatically using simple English instructions and a few lines of code [8]. This platform can be integrated into various applications such as industrial automation, process monitoring, retail analytics and robotics. An example can be the task when it is necessary to identify "Is the cart blocking the aisle?" based on this query, the answer is then implemented using the recognition of current records, see Figure 1. This technology is already implemented in Auster Manufacturing in Washington State.
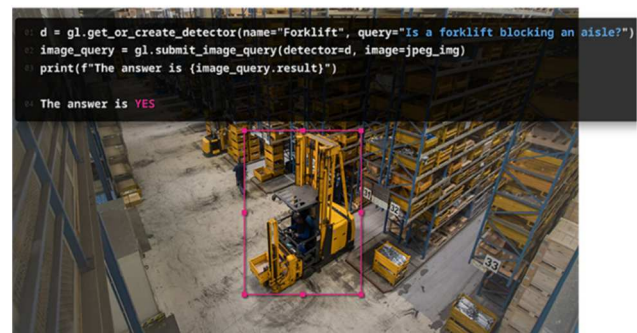

Figure 1 Visualization of the process of identifying a response to a request for information [8]

Another example that outlines the future use of GPT is the application in robotics shown by the Microsoft study [9]. Robotics is one of the fascinating areas where ChatGPT can be used to translate natural language commands into executable code to control robots. The advantage of adopting ChatGPT for robotic applications is that they can start with a modest amount of sample data to adjust the model for specific applications and use its language recognition and interaction capabilities as an interface, see Figure 2. Although the potential of ChatGPT for robotic applications is gaining attention, there is currently no proven approach for practical use.
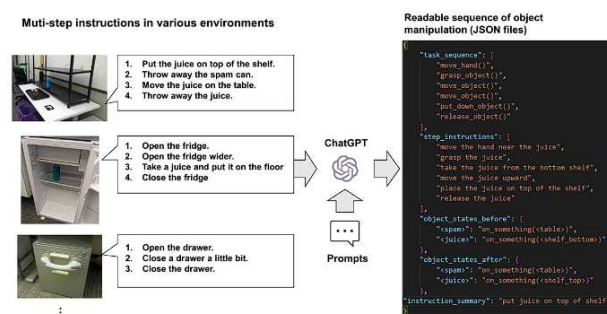

Figure 2 Visualization of the process of identifying a response to a request for information [9]

With the right design, GPT can also have another effect in the field and in the context of controlling machines with the help of commands in the code [10]. It is common that sometimes there is an error in the code that a trained

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programmer has to look for and often has to look for it directly on the spot while the machine can be turned off. A solution in the future could be a self-correcting "tool for artificial intelligence that corrects errors in the code. When a user runs their Python program and it crashes, the Wolverine -created tool teams up with the GPT-4 AI to fix the program and explain what went wrong. Wolverine's code is available on GitHub , and the developer says the technique could be used in other programming languages.

3.1 GPT Agents

AI "agents" capable of multi-tasking are another area where GPT models prove advantageous in a manufacturing context. These agents are essentially self-contained systems that use modern generative AI models to automate tasks. Most agents use OpenAI's ChatGPT and GPT-4 as a base, but several home agents also include generative AI models for images and voice to create surprising, if sometimes creepy, effects. These agents use the power of GPT models to automate various processes. For example, if you wanted an AI agent to create a plan to upgrade your computer on a limited budget, you could assign it tasks like "find and compare the latest graphics cards based on price under $500" and then the same for CPU, RAM and others. However, these benefits that GPT brings to manufacturing come with their own challenges. While these models have the ability to automate and streamline many processes, they also bring the potential for error. Developers must be vigilant to monitor AI output and possibly correct any errors that may arise. Despite these challenges, GPT models are a huge asset to manufacturing and industry, and their use in these areas will continue to grow in the coming years [11,12].

3.2 GPT in Microsoft Excel

Microsoft Excel has long been a basic tool for companies and individuals. It is a universal program that allows users to organize and analyze data in many ways. However, as the amount of data that companies and individuals work with grows, so does the need for more efficient methods of processing and analysis. This is where artificial intelligence (AI) comes in, and specifically Chat GPT. According to [13], one of the most powerful use cases of Chat GPT in Excel is the ability to generate natural language queries. Traditional Excel queries can be complex and require a deep understanding of the program's functions and syntax. But with Chat GPT, users can easily ask a question in plain language and get an answer in the same language. Another use case for Chat GPT in Excel is cleaning and formatting data. Data can exist in many different formats and may require cleaning and formatting before it can be analyzed. This can be a time-consuming process, especially with large data sets. With Chat GPT, users can simply input data and ask it to clean and format it for them. Of course, this does not happen in Excel itself, but in the GPT tool. Predictive analytics is the use of

statistical algorithms and machine learning techniques to analyze historical data and predict future events. This can be a complex process that requires a deep understanding of statistical methods and programming languages. But with Chat GPT, users can simply input data and ask it to make predictions for them. Data quality is an important aspect of data analysis, but it can be difficult to ensure that the data is clean and accurate. With Chat GPT, users can perform quality checks on their data by entering data and asking Chat GPT to identify any errors or inconsistencies. One of the most important features of GPT is the possibility to create codes for VBA that allow automating most tasks without a person having extensive knowledge of programming [14].

4 Discussion

As the analysis shows, GPT models such as GPT-4 can have a significant impact not only on the manufacturing sector, but also on everyday tools such as Microsoft Excel. In the context of manufacturing, GPT models show promising potential for automation and robotics. From the point of view of a specific application in Excel, GPT brings new possibilities and improves the user experience. One of the key benefits of GPT in Excel is the ability to formulate and answer queries in natural language, which facilitates interaction with the program for users without deep knowledge of Excel's functionality and syntax. Furthermore, GPT can greatly help with cleaning and formatting data, which is often a time-consuming and complicated process. GPT can also help with predictive analytics and data quality control, which are critical aspects of working with data in an enterprise environment. Finally, one of the most advanced capabilities of GPT in Excel is code generation for VBA, which makes it possible to automate most tasks without requiring the user to have extensive programming knowledge. This is an example of how GPT models open up new possibilities and simplify processes, which is in line with their potential in the field of manufacturing process automation and robotics, which we discussed earlier. Although GPT models offer many advantages, it is important to remember that there are still challenges and issues that need to be addressed. These include demands on computing resources, possible errors in generating responses, and ethical and safety issues regarding their use. These issues require further research and discussion. However, given the great potential of GPT models in manufacturing and in common tools such as Excel, their use is expected to only increase in the future.

5 Conclusions

The paper concludes that GPT models like GPT-4 offer substantial potential in manufacturing and tools like Excel, enhancing automation, robotics, and user experience. Key benefits include natural language query handling, data cleaning, and predictive analytics in Excel, paralleling their advantages in manufacturing automation and robotics.

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Despite these benefits, challenges such as computational demands, potential errors, and ethical concerns need addressing. With ongoing research and development, the application of GPT models in these areas is expected to grow, underscoring their significant impact on the industry.

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