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INTEGRATION AND USE OF ARTIFICIAL INTELLIGENCE FOR AUTOMATED MACROS CREATION

In today's world, automation and optimization of work processes are becoming key success factors. This work examines the combination of automation systems and artificial intelligence (AI) and their impact on the optimization of work processes. The technology of integration into the process automation system and learning of a large language model for the automated creation of macros using the example of the author's software "Draw & GO" has been developed and proposed.
Keywords: automation and optimization of workflows, macro, human-machine interaction, artificial intelligence, LLMs, Prompt Engineering, computerized devices.

Statement of the problem. In today's increasingly valuable world, automation and workflow optimization are becoming key success factors. Systems that allow you to automate routine tasks and organize work significantly increase productivity and efficiency.

The system of automation and organization of work processes includes:

- Macros are sets of commands that automate repetitive tasks. They can be used to automate almost any task that can be done manually, from data entry to text formatting.
- Workflow programs are more complex systems that allow you to automate entire task chains. They can include conditional statements, loops, and other logical elements, making them more flexible and powerful than macros.

«Draw & GO» [1] is an innovative cross-platform workflow system that is built on the microkernel onion architecture [2] of plugins using .NET MAUI and Blazor technologies [3], implements interaction based on graphic gesture recognition [4], allows users to create powerful and secure workflows customized according to the needs and preferences of each client based on specific conditions, actions and triggers in a secure environment of industry standards.

A relevant area of research is the use of artificial intelligence in automation and workflow systems, which is based on a number of key factors:

1. Data Growth: The world is generating unprecedented amounts of data that humans cannot analyze on their own. AI makes it possible to process and interpret this data, revealing hidden patterns and gaining valuable insights.

2. Personalized experiences: AI enables you to create personalized experiences for users based on their individual needs and preferences. This leads to better customer engagement and loyalty.

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3. Improved decision-making: AI can aid in better decision-making by providing data-driven analytics and predictions. This leads to better results in business, science, and other areas.

The combination of automation and workflow systems with AI makes them extremely powerful tools that can significantly improve operational efficiency in various areas:

1. Automate complex tasks: AI can be used to automate complex tasks that previously required human intervention. For example, AI can be used to:

- Data analysis: AI can automatically analyze large amounts of data to identify patterns and make predictions. This can be used to automate tasks such as demand forecasting, fraud detection, and price optimization.
- Natural Language Processing: AI can be used to understand and generate human language. This can be used to automate tasks such as customer service, report writing, and text translation.
- Computer vision: AI can be used to analyze images and videos. This can be used to automate tasks such as quality control, object recognition, and robot navigation.

2. Adaptive automation: AI can be used to create adaptive automation programs that can self-learn and adjust as they work.

3. Increased productivity: AI can be used to improve the productivity of automation applications. This will help in reducing the time and errors that may occur when manually completing tasks.

AI applications are becoming more accessible and versatile. They are used by a wide range of organizations, from small businesses to large corporations, as well as government and non-profit organizations.

This article discusses the possibilities of using AI in process automation systems to improve their capabilities using the example of the "Draw & GO" system.

Analysis of the latest research and publications. Today's important advances in artificial intelligence are large language models (LLMs) and Prompt Engineering technologies [5-6]. Some of the most popular large language models include:

- OpenAI GPT (Generative Pre-trained Transformer) is known for its ability to generate coherent, informative text based on the instructions it receives;
- Gemini, which is an attempt to create a more versatile and efficient language model capable of adapting to a variety of language processing tasks;
- Facebook AI LlaMa, which is also a high-performance model designed for a variety of applications in the field of natural language processing.

With the advent of language models, the term Prompt Engineering emerges. Prompt Engineering is a relatively new discipline for developing and optimizing prompts for the effective use of language models for a wide range of applications and research topics [7].

Some of the most popular Prompt Engineering techniques are:

- Prompt chaining is a method where a task is broken down into subtasks in order to create a chain of operational operations [8].
- Few-shot learning is a method that allows a language model to learn from a small number of examples. This method can be used to train a language model to perform new tasks for which there is not a lot of data [9].

- Zero-shot learning is a method that allows a language model to perform tasks without having any training data. This method uses the knowledge that the language model has gained during previous training in order to generalize to new tasks [10].

Objective. The purpose of this work is to investigate the combination of automation and AI systems and their impact on the optimization of workflows, to review existing solutions, to identify key factors that affect the successful combination of automation systems and AI, to propose a technology for integrating and training a large language model for automated creation of macros in a process automation system, to implement practical testing of the proposed technology in the "Draw & GO" system, develop recommendations for the effective use of automation systems and AI to optimize workflows.

Presentation of the main material of the research. In this work, the technology of integration and training with hints of the language model into process automation systems has been developed on the example of the "Draw & GO" automation system.

The proposed technology allows users to build workflows, describing only the requirements for them, without the need to delve into knowledge of programming or even the system itself, and consists of the following steps:

1. Choosing a language model of artificial intelligence. After analyzing the integration capabilities of LLMs, it was found that Open AI provides the easiest way to use it, so let's consider this particular language model. Currently, AI from Open AI offers two popular models: GPT-3.5 and GPT-4. While both models are based on transformation architecture, GPT-4 tentatively shows more improvements in accuracy, master learning ability, and pattern recognition. However, GPT-4 is a more expensive and slower model because it provides a more detailed answer. After comparing both models and the quality of the result, it was chosen to use the GPT-3.5 model.

2. We connect libraries to work with Open AI. To connect the model, the OpenAI Sdk NuGet package was used [11].

3. We carry out prompt engineering in order to train the AI model to understand the system. It is necessary to conduct several experiments to determine which prompt engineering techniques are best to apply and what information will be sufficient to return the correct data. For example, to integrate AI with the Draw & GO system, the following instructions for using each macro command were developed:

3.1. We provide a basic role so that the system adapts the answers as if it were an expert in the field. Prompt: "*You know how to use Draw & GO plugins".*

3.2. We provide a list of macros available in the system so that the language model returns results that Draw & GO will understand. Prompt: «*You know such plugins as: Start, Search, ConsoleLog, SendEmail, Text, Number, Boolean».*

3.3. We provide basic information about the macro command. Prompt: «*Each plugin has its own set of parameters. The parameter has its name, type, and value. The parameter name is a string. The parameter value is an object. The parameter type is a string. The parameter type can be one of the following: string, number, boolean, or any.*

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Each plugin has its own set of Connectors. There can be input and output connectors. Input connectors are used to connect plugins. Output connectors are used to connect plugins. Output connectors can only be set to input connectors».

3.4. We provide detailed information about each parameter for each macro command. Prompt: *«The start plugin has no input connectors. The start plugin has one output connector. The start plugin has no parameters.*

The start plugin has a single output parameter with the name Start.

The search plugin has one input connector with the name In. The search plugin has one output connector with the name Out. Search plugin has 2 parameters: Search (with type string) and SearchProvider (with type string).

ConsoleLog plugin has one input connector with the name In. The search plugin has one output connector with the name Out. Console plugin has 1 parameter: Message (with type string). »

3.5. If necessary, we provide constraints or rules for the overall system, which will help narrow down the answer to a more accurate result. Prompt: «*Macros must contain one and only one Start plugin. It's the start of the flow execution. »*

3.6. We provide information about what requests will be made and how the system will be used. Prompt: «*The user will ask you to generate a flow diagram for Draw & GO plugins in general format. You will need to understand the user's request and generate a flow diagram for Draw & GO plugins. »*

3.7. Set the view in which you expect to get the result. Prompt: «*In output, you must provide a valid JSON object with plugins and links (connectors). Example valid output:*

```
{
    "name": "Weather in Dnipro",
    "macroCommands": [{
          "Type": "DrawGo.Plugin.Essentials.Extensions.Start",
          "Id": "68B34584-7649-4582-974F-FA8608570D58",
          "Position": "0:0",
          "FieldData": []
       },{
          "Type":
"WebExtensions.SearchMacroCommand.SearchMacroCommand",
          "Id": "E7625C90-C643-4CA7-B093-7374BE9DBC71",
          "Position": "199:266",
          "FieldData": [
             {"DataType": 5,"Key": "Search","Value": "Weather in
Dnipro"},
             {"DataType": 5,"Key": "SearchProvider", "Value":
"Google"}]}],
    "links": [{
          "DestinationKey": "In",
          "DestinationNode":          "E7625C90-C643-4CA7-B093-
7374BE9DBC71",
          "SourceKey": "StartFlow",
          "SourceNode": "68B34584-7649-4582-974F-FA8608570D58"
```

}]

} »

3.8. After the general settings, the system is ready to accept commands from users. It should be emphasized that users do not need to have deep technical knowledge or learn complex command syntax to form these commands.

The system is designed to use ordinary human language to formulate queries, similar to how people type queries into search engines like Google. For example, the user can simply type "open mail" or "launch music player", and the system recognizes and executes these commands accordingly. An example of such a command would be:

«Generate a flow diagram for Draw & GO plugins.

I want to search for a Smart Home in Bing. I want to write a log message with text containing the current date and time. »

As a result, we get the following answer (Fig. 1):


```
{
  "name": "Smart Home Search and Log",
  "macroCommands": [
    {
      "Type": "DrawGo.Plugin.Essentials.Extensions.Start",
      "Id": "1",
      "Position": "0:0",
      "FieldData": []
    },
    {
      "Type": "WebExtensions.SearchMacroCommand.SearchMacroCommand",
      "Id": "2",
      "Position": "200:100",
      "FieldData": [
        {"DataType": 5,"Key": "Search","Value": "Smart Home"},
        {"DataType": 5,"Key": "SearchProvider","Value": "Google"}]},
    {
      "Type": "DrawGo.Base.Extensions.Logs.ConsoleLog",
      "Id": "3",
      "Position": "400:200",
      "FieldData": [{"DataType": 5,"Key": "Message","Value": "Current Date and
        Time"}]}],
  "links": [
    {
      "DestinationKey": "In",
      "DestinationNode": "2",
      "SourceKey": "StartFlow",
      "SourceNode": "1"
    },
    {
      "DestinationKey": "In",
      "DestinationNode": "3",
      "SourceKey": "Out",
      "SourceNode": "2"
    }
  ]
}
```


Figure 1 - AI-generated result

The result obtained in the "Draw & GO" system is automatically converted into a macro that can be used in the future (Fig. 2):

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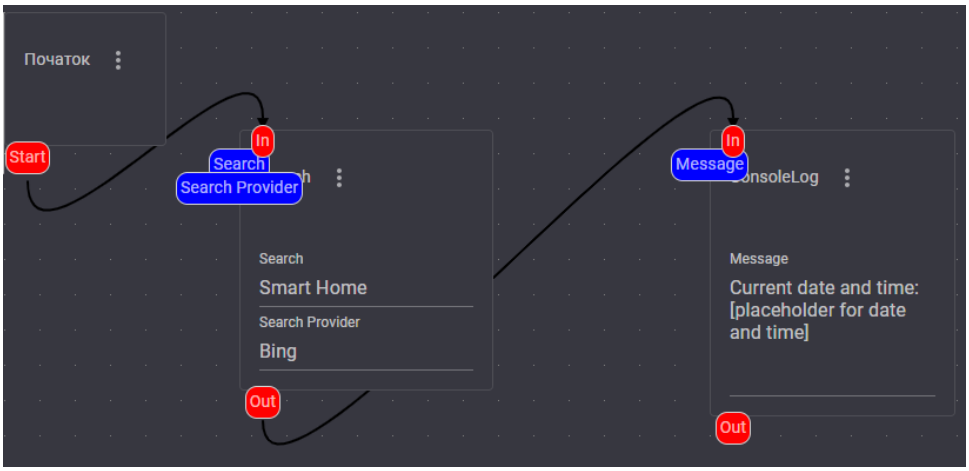

Figure 2 - Macro generated by artificial intelligence in the "Draw & GO" system

Conclusions. This paper proposes a technology for integrating and training a language model for automated creation of macros in the context of the author's software "Draw & GO". The use of AI significantly expands the capabilities of users and makes the development of customer-oriented applications more intuitive and accessible. The combination of automation and AI systems has great potential to streamline workflows and increase productivity. AI can help automate complex tasks, improve decision-making, and create personalized experiences for users. It's important to choose and implement the right automation and AI systems to get the most out of your investment. This research will help to improve the understanding of the potential of combining automation and AI systems to optimize workflows. The results of the study can be used to develop more efficient and effective automation and AI systems. The study's recommendations will help organizations of all sizes and industries successfully implement automation and AI systems to optimize their workflows.

Further research in this area may focus on developing new methods and algorithms for automating workflows using AI, studying the impact of combining automation systems and AI on the workforce and society as a whole, and developing ethical norms and guidelines for the use of AI in work processes.

REFERENCES

1. Draw & GO, URL: https://drawgo.azurewebsites.net.
2. Antonyuk V., Sydorova M. (2021) Synthesis of software architectures for cross-platform application development. *Actual problems of automation and information technology*. Vol.25. PP. 3-12. DOI: 10.15421/432101
3. Antonyuk V., Sydorova M. (2022) A Cross-Platform Mobile Development for accelerating software development lifecycle. *Actual problems of automation and information technology*. Vol.26. PP. 3-8. DOI: 10.15421/432201
4. Antonyuk V., Sydorova M. (2023) The concept of associative graphical interface in the workflow automation system. *System technologies*. Vol. 5 No. 148. PP. 133-140 DOI: 10.34185/1562-9945-5-148-2023-12

5. Reynolds L, McDonell K. (2021) Prompt programming for large language models: beyond the few-shot paradigm. *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems* P. 1–7. URL: doi.org/10.48550/arXiv.2102.07350
6. Kojima T, Gu SS, Reid M, Matsuo Y, Iwasawa Y. (2022) Large language models are zero-shot reasoners. *Advances in Neural Information Processing Systems*. 35:22199–22213. URL: doi.org/10.48550/arXiv.2205.11916
7. Prompt Engineering Guide, URL: https://www.promptingguide.ai/
8. B. Chen, Z. Zhang, N. Langrené, S. Zhu (2023) Unleashing the potential of prompt engineering in Large Language Models: a comprehensive review. URL: doi.org/10.48550/arXiv.2310.14735
9. P. Liu, W. Yuan, J. Fu, Z. Jiang, H. Hayashi, G. Neubig (2021) Pre-train, Prompt, and Predict: A Systematic Survey of Prompting Methods in Natural Language Processing. URL: doi.org/10.48550/arXiv.2107.13586
10. Brown T.B, Mann B, Ryder N, Subbiah M, Kaplan J, Dhariwal P, et al. (2020) Language models Are Few-Shot Learners. *Proceedings of the 34th International Conference on Neural Information Processing Systems. NIPS'20* URL: doi.org/10.48550/arXiv.2005.14165
11. C#/.NET SDK for accessing the OpenAI APIs URL: https://github.com/OkGoDoIt/OpenAI-API-dotnet

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Інтеграція та використання штучного інтелекту для автоматизованого створення макросів

В сучасному світі, де час стає дедалі цінішим ресурсом, автоматизація та оптимізація робочих процесів перетворюються на ключові фактори успіху. Системи, які дозволяють автоматизовувати рутинні завдання та організовувати роботу, значно підвищують продуктивність та ефективність. Прикладом такої системи є "Draw & GO" [1] – ефективне та гнучке кросплатформне програмне забезпечення автоматизації робочих процесів та взаємодії з комп'ютеризованими пристроями, яке забезпечує управління на основі графічних жестів та інтеграцію з будь-якими існуючими сторонніми службами.

Штучний інтелект (ШІ) має великий потенціал для революційних змін у багатьох сферах. Актуальним напрямом є дослідження можливостей його застосування у системах автоматизації та організації робочих процесів, зокрема інтеграція великих мовних моделей та донавчання їх за допомогою навчання з підказками.

Метою цієї роботи є дослідити поєднання систем автоматизації та ШІ та їх вплив на оптимізацію робочих процесів, провести огляд існуючих рішень, визначити ключові фактори, які впливають на успішне поєднання систем автоматизації та ШІ, запропонувати технологію інтеграції та навчання великої мовної моделі для автоматизованого створення макросів у системі автоматизації процесів, реалізувати практичну апробацію запропонованої технології у системі "Draw & GO", розробити рекомендації щодо ефективного використання систем автоматизації та ШІ для оптимізації робочих процесів.

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Дослідження показало, що поєднання систем автоматизації та ШІ має великий потенціал для оптимізації робочих процесів та підвищення продуктивності. ШІ може допомогти автоматизувати складні завдання, покращити прийняття рішень та створити персоналізований досвід для користувачів. Однак важливо правильно вибрати та впровадити системи автоматизації та ШІ, щоб отримати максимальну віддачу від інвестицій.

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