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Development of an AI-Based Script for The DJI Tello Edu Drone Using the ChatGPT O1 and Copilot Platforms

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ABSTRACT

The rapid advancement of drone technology, particularly in its integration with artificial intelligence (AI), has had a significant impact on various sectors, one of which is the field of aircraft inspection and maintenance. This study aims to develop an AI-based script using the ChatGPT O1 and Microsoft Copilot platforms to control the DJI Tello EDU drone in automatically detecting cracks on aircraft bodies. The research was conducted through several stages, including collecting visual data via drone flights, processing and training the model using machine learning, developing the script with AI assistance, simulating on MATLAB Simulink, and finally implementing and testing directly on the physical drone. The results of the study indicate that ChatGPT O1 is capable of generating scripts that are more responsive, comprehensive, and easier to understand compared to Copilot, especially in interpreting natural language prompts. The generated scripts proved effective in both simulations and real-world flight tests, although there were limitations in the drone's sensors that affected the accuracy of altitude and distance measurements. The conclusion of this research is that AI plays a significant role in simplifying drone programming processes and enhancing work efficiency. This study contributes to the development of AI-based autonomous drone technology and opens up opportunities for broader and more efficient applications in other infrastructure inspection fields.

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INTRODUCTION

Advances in digital technology have had a major impact on various aspects of life, including transportation, industry, and monitoring systems. One rapidly developing innovation is the drone or Unmanned Aerial Vehicle (UAV), which is now used not only for military purposes but also in mapping, agriculture, and building and infrastructure inspection. With the advent of Society 5.0, which emphasizes the integration of technology and humans through artificial intelligence (AI) and big data, the use of drones combined with AI has become increasingly important. This combination enables drones to perform tasks autonomously, such as navigation, object recognition, and real-time visual analysis. [1]

In the aviation industry, aircraft inspections are still largely conducted manually by technicians who perform visual checks on the exterior of the aircraft, including detecting cracks. This method is not only time-consuming but also poses safety risks and has limitations in terms of accuracy. Therefore, a more efficient and intelligent solution is needed, one of which is through the use of drones programmed to automatically detect cracks. This research is a continuation of a previous project by [2]who developed a DJI Tello drone control script based on artificial intelligence using the ChatGPT and Copilot platforms. This follow-up research aims to develop the capabilities of the DJI Tello EDU drone to detect damage to aircraft bodies by leveraging AI sophistication, as well as utilizing the capabilities of ChatGPT-o1 and Copilot in generating programming scripts for drone navigation and visual data processing.

Based on the identified issues, this study focuses on two main aspects. First, this study discusses the ability of scripts generated by ChatGPT-o1 and Microsoft Copilot to effectively control the DJI Tello drone. These scripts are evaluated in terms of command accuracy, compatibility with the drone control system, and suitability for navigation needs. Second, this study examines how the ChatGPT-o1 and Microsoft Copilot platforms can be utilized to develop programming scripts that enable the DJI Tello drone to navigate realtively complex trajectories autonomously. The research focuses on the process of developing AI-based automated scripts, without addressing crack detection aspects, thus limiting the scope to drone control and navigation patterns within a test environment.

Previous studies have demonstrated the relevance between drone control and the use of artificial intelligence. [3] showed that the use of ChatGPT-4 in controlling the DJI Tello drone can simplify human-drone interaction processes and expand its potential applications. [4] also demonstrated that LLM models like ChatGPT can be used in robotics system development, enabling more intuitive communication between humans and robots. [5] proved that the CNN U-Net model can perform crack segmentation on runways using images captured by drones, even with a limited training dataset. Meanwhile, [6] utilized computer vision and CNN methods in detecting building damage, showing that this model can accurately distinguish between cracked and non-cracked pixels without manual feature extraction. On the other hand, [7] emphasized the importance of AI and robotics in the industrial sector to improve efficiency and productivity.

Based on this background and literature review, the objective of this study is to develop an AI-based script using the Chat GPT and copilot platforms to create flight paths for aircraft using DJI Tello EDU drones, and to assess the effectiveness and accuracy of the AI script on drones. This research is expected to provide a tangible contribution to supporting more efficient, safe, and future-oriented aircraft inspection processes[8]

Figure 1. Drone Dji Tello used in the study

METHODS

This research method aims to develop a script for automatically controlling the flight path and trajectory of a DJI Tello EDU drone with the help of artificial intelligence, specifically through the ChatGPT and Copilot platforms. The initial stages begin with preparing the hardware and software, such as a laptop, DJI Tello EDU drone, and software like MATLAB, Simulink, and PyCharm. These tools are used for script development, flight path simulation, and flight implementation testing.

The next stage is the development of control scripts using AI assistance, leveraging ChatGPT and Copilot to obtain and compile drone programming code. The developed scripts are designed to control basic and complex drone maneuvers, including movements such as takeoff, flying in specific patterns, and landing. These scripts are first tested through simulation using MATLAB Simulink to ensure the drone's control logic functions as intended[9].

After successfully passing the simulation, the script is converted into Python so it can be run directly through PyCharm on the physical drone. Testing is conducted in two schemes: simulation testing and field testing. Field testing includes two types of tests: basic movement tests and complex movement tests. Basic movement tests include simple flights such as take-off, square trajectories, and landing, while complex movement tests are conducted with more complicated trajectory patterns and outdoors, under varying environmental conditions. During the testing process, observations are made to ensure that the drone can follow the predetermined trajectory properly[10]. To provide a visual overview of the stages involved in this study, the following diagram shows the systematic flow of the research process.

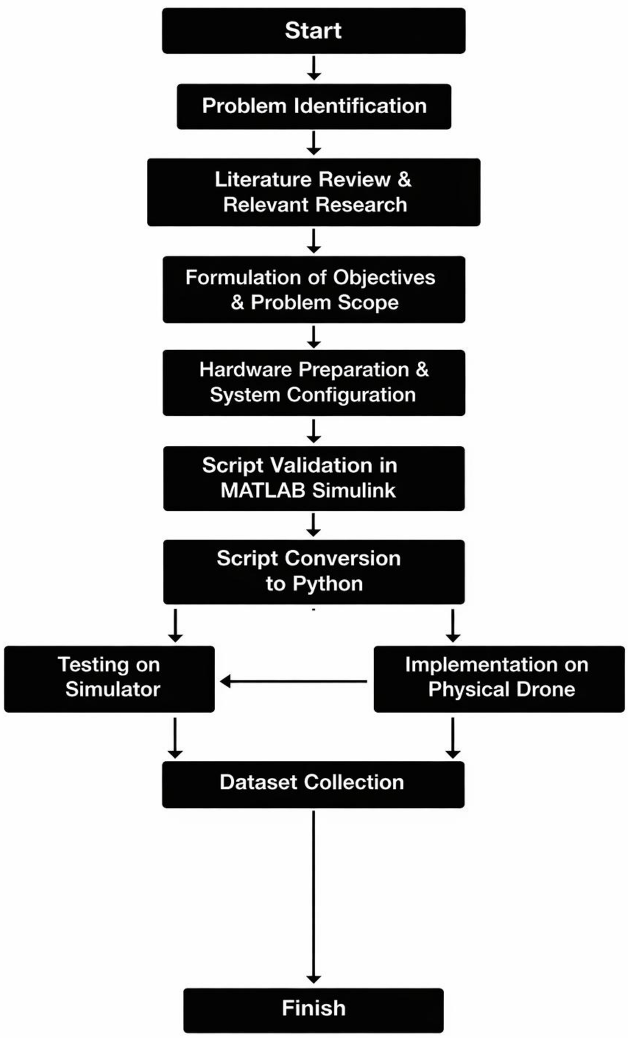

Figure 2. Flowchart

RESULT AND DISCUSSION

Script Drone Dji Tello from ChatGPT and Copilot

This research produced an automation script for controlling the DJI Tello EDU drone to perform maneuvers along a predetermined flight path, both for simple and complex patterns. The script was developed with the help of AI platforms, namely ChatGPT o1 and Microsoft Copilot, using prompts in two languages, Indonesian and English. The results show that ChatGPT o1 is capable of responding to commands in Indonesian quite well and generating Python scripts that can be run directly to control the drone. For simple movement patterns, such as forming a rectangular path with specific dimensions, ChatGPT O1 generates appropriate scripts accompanied by code explanations that aid user understanding[11].

In testing complex movement patterns, ChatGPT o1 provided better scripts when the prompt was written in English. The AI's response to the international language tends to be more accurate and comprehensive, especially in explaining the logic and structure of the code. Additionally, the addition of video streaming via the drone's camera was successfully implemented by integrating additional scripts using the OpenCV library, based on the prompts from ChatGPT o1[9]. The script enables the drone to record the flight process from before takeoff to landing[12].

As a comparison, Microsoft Copilot was also tested with the same prompt. Initially, Copilot did not provide satisfactory results, primarily because it did not explicitly include drone control libraries such as djitellopy. However, after being directed to the appropriate library, Copilot was able to generate scripts comparable to ChatGPT o1. These results indicate that Copilot's effectiveness is highly dependent on the clarity of initial instructions.

From all testing results, both through simulation and direct field testing, the DJI Tello EDU drone can follow the flight path fairly well, especially when using the script generated by ChatGPT o1 in English. This indicates that the use of AI like ChatGPT o1 in drone control system development has great potential to accelerate the coding process and enable users without a strong programming background to operate drones automatically.

Overall, the results of this study show that integrating AI into the drone scripting process provides significant efficiency and effectiveness. ChatGPT o1 excels in language flexibility and explanation quality, while Copilot can be a viable alternative with good results when provided with more specific technical input. These findings can serve as a reference for the development of AI-based drone control systems in the future, whether for educational, research, or industrial applications.

Trajektori Drone

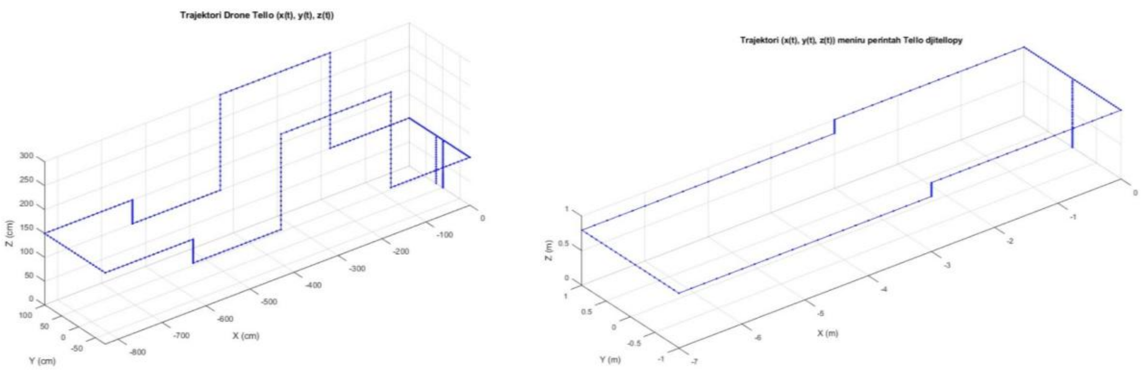

Figure 3. Sample drone trajactories used in the study

In this study, simulations of the trajectory of a DJI Tello drone were conducted using scripts generated from the ChatGPT and Copilot platforms. The simulations were carried out in the Matlab Simulink environment to ensure that the designed trajectory could run properly before being implemented on a physical drone. Three main tests were conducted based on the language and source of the script creation, namely using Indonesian, English, and specific path shapes such as rectangles.

In the figure, the X and Y axes represent the drone's horizontal position, while the Z axis depicts the drone's altitude or elevation above the surface. The dotted blue line marks the drone's flight path based on the script developed using the ChatGPT O1 AI platform, and it is visualized to verify the accuracy of navigation commands such as takeoff, move_right, move_up, move_forward, and land.

The first test showed a rectangular trajectory formed through a script from ChatGPT o1 with a Python algorithm converted to JavaScript so it could be used in Matlab Simulink. The results showed a precise and stable trajectory in line with the desired shape. This indicates that the generated script is capable of creating a structured drone flight path that can be well represented in the simulation.

Next, testing was conducted using a script generated by ChatGPT through a prompt in Indonesian. The simulation results showed that the generated flight path remained consistent and accurate in forming the drone's flight pattern. This success indicates that Indonesian can be used as input in designing drone command scripts with ChatGPT's assistance without compromising the accuracy of the results.

The final testing used scripts from Copilot with English prompts. Simulation results in Matlab Simulink showed that Copilot was also capable of generating suitable scripts, and the drone flight paths reflecting the real world, shows that this approach can be relied upon to support drone navigation design in various flight scenarios. When tested in both simulations and physical drones.

Overall, the results of the three tests prove that artificial intelligence (AI)-based platforms can be run effectively. This is evidenced by the fact that ChatGPT and Copilot can help design drone trajectories effectively, both in Indonesian and English. The accuracy of the simulation results resembles the movements of a drone[13].

Check Point Results

Figure 4. Check point that must be followed by the drone

Test results at checkpoints show that although the DJI Tello drone is capable of following flight patterns programmed via scripts from ChatGPT-o1 and Microsoft Copilot, there is a discrepancy between the specified path and the path taken by the drone in real time. This is not due to errors in the script, but rather the technical limitations of the drone itself, which only uses a single sensor on the bottom to measure altitude and distance traveled. This sensor is not accurate enough to ensure the drone flies precisely according to the specified dimensions. However, the drone is still able to complete the flight pattern in full, starting from the initial point, following the path according to the prompt, and returning to the initial point. Based on these findings, it can be concluded that the generated script has effectively managed to control complex flight patterns, while the issues encountered are primarily due to the drone's hardware limitations, which may cause path deviations or hovering outside the expected points[13].

Data Set

Figure 5 shows the documentation of the image data collection process for cracks on the fuselage of a Cessna aircraft using a physical drone. This test was part of a field experiment conducted by fellow researchers to gather visual data as the basis for training a crack detection model.

During the data collection process, the Python programming platform was utilized through the PyCharm IDE, along with additional libraries such as OpenCV. This library enabled the Python script to directly access the drone’s camera and automatically capture images.

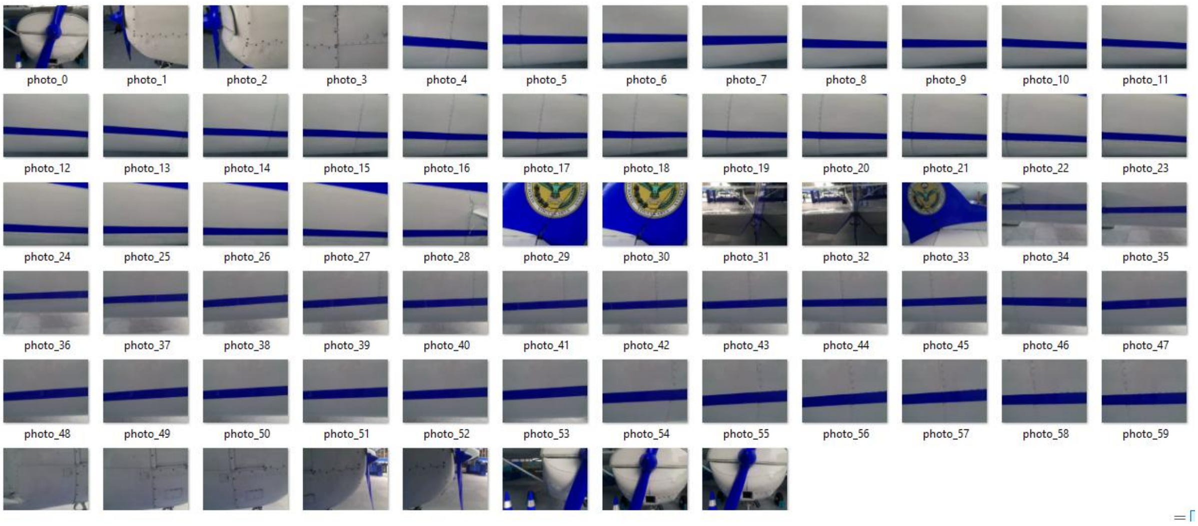

Figure 5. Sample of data cessna collected during the drone flight

A total of 134 images were successfully captured and stored in a dedicated directory. This dataset will be used as training material in the development of an Artificial Intelligence (AI)-based crack detection system, which will later be integrated into the DJI Tello EDU drone control script to enable automatic crack detection.

The data collection was conducted systematically by considering factors such as position, distance, and angle of capture to ensure sufficient image variation, thereby supporting more accurate model training.

CONCUSIONS

Based on the research results, it can be concluded that the use of artificial intelligence platforms such as ChatGPT O1 and Microsoft Copilot has proven effective in assisting the programming process of the DJI Tello EDU drone. Through natural language-based commands, users can quickly develop flight control scripts that are accurate and easy to understand. Test results in both MATLAB Simulink simulations and on physical drones show that the generated scripts are capable of directing the drone to fly according to the instructions given, whether in simple or complex patterns. ChatGPT O1 is considered superior in generating complete scripts accompanied by functional explanations, while Copilot is still capable of producing good results after technical adjustments.

However, this study has several limitations. First, the study only focuses on the use of the DJI Tello EDU drone, which has limitations in terms of navigation sensors and distance accuracy. Second, the scope of the developed scripts is limited to flight control and image capture, without integrating automatic image analysis functions. Third, testing was only conducted in a limited environment with specific lighting and weather conditions, so it does not fully reflect real-world conditions. Fourth, the validation process emphasized trajectory precision and command execution success rather than real-time crack detection capabilities. Finally, the use of AI was focused on only two platforms, ChatGPT O1 and Microsoft Copilot, without comparison to other AI models or systems.

Based on these findings and limitations, it is recommended that future research use more advanced drone types, such as the DJI Neo, which is equipped with more accurate navigation systems and sensors. Additionally, integration with supporting technologies such as GPS, additional sensors, and machine learning-based image processing algorithms like Convolutional Neural Networks (CNN) or YOLO can enhance the accuracy of automatic crack detection. Further research should also be conducted under various real-world environmental conditions to comprehensively test the system's performance and its applicability in the context of aircraft maintenance and inspection industries.

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