**ABSTRACT**

This paper proposes an innovative approach to identify and track aerial vehicles in real-time using a Software Defined Networking (SDN) architecture. The proposed architecture utilizes the OpenFlow protocol to provide dynamic control and management of network traffic, which enables efficient identification and tracking of aircraft and drones. The implementation of the architecture involves the use of sensors and algorithms to capture and process data related to the identification of aerial vehicles. The data is transmitted in real-time to a central server via a Virtual Private Network (VPN). The proposed approach has been evaluated, and the results demonstrate its effectiveness in accurately identifying and tracking aerial vehicles. The proposed SDN architecture presents a viable solution for managing the increasing number of drones and aircraft in the airspace, which is crucial for improving safety and security.

**INTRODUCTION**

The rapid growth in the number of unmanned aerial vehicles (UAVs) or drones in recent years has raised concerns over their potential to pose security risks, especially in restricted airspace. With drones becoming more accessible to the general public, there is an increased risk of unauthorized drone flights in restricted airspace, such as near airports, military bases, and critical infrastructure. This has led to a growing need for reliable and effective systems to detect, track, and identify aerial vehicles in real-time.

In this paper, we propose a Software Defined Networking (SDN) architecture to identify and track aerial vehicles in real-time. The proposed architecture utilizes the OpenFlow protocol to provide dynamic control and management of network traffic, which enables efficient identification and tracking of aircraft and drones. The implementation of the architecture involves the use of sensors and algorithms to capture and process data related to the identification of aerial vehicles. The data is transmitted in real-time to a central server via a Virtual Private Network (VPN).

The proposed approach has several benefits, including accurate identification and tracking of aerial vehicles, improved safety and security in the airspace, and reduced risk of unauthorized drone flights in restricted airspace. The proposed SDN architecture presents a viable solution for managing the increasing number of drones and aircraft in the airspace, which is crucial for improving safety and security. The remainder of this paper is organized as follows. In the next section, we provide an overview of the proposed approach, followed by a detailed description of the methods used for implementation. We then present the results of our evaluation and discuss the implications of our findings. Finally, we conclude with a summary of the contributions of this paper and suggestions for future work.

**METHODS**

Software Defined Networking (SDN) is a network architecture that enables network administrators to manage and control network behavior using software. SDN technology has found increasing use in various fields, including identifying and tracking aerial vehicles in real-time. This paper proposes the use of SDN technology in combination with machine learning algorithms to identify and track aerial vehicles such as drones and aircraft.

The proposed solution involves designing an SDN architecture that can identify and track aerial vehicles in real-time. The architecture includes sensors such as radar, cameras, and acoustic sensors that detect and track aerial vehicles flying in the air real-time. The sensors are connected to the SDN controller, which uses machine learning models to analyze the sensor data and identify the aerial vehicles. The SDN architecture is designed to securely transmit the data to the central server or agency via a VPN.

To implement this solution, the first step is to design an SDN architecture that can identify and track aerial vehicles in real-time. This involves selecting the appropriate sensors to be used in the system and designing the architecture to support real-time data processing. The architecture should also be designed to ensure secure transmission of data to the central server or agency.

The next step is to deploy the SDN architecture in the area where aerial vehicles are expected to fly. The sensors are strategically placed to provide maximum coverage of the area, and the switches are configured to forward data to the SDN controller. The servers are configured to receive and process the data collected by the sensors.

The machine learning models used by the SDN controller to identify aerial vehicles are trained using data collected by the sensors during the deployment of the SDN architecture. Convolutional Neural Networks (CNN) are an appropriate algorithm for this project, given their ability to process visual data and their suitability for real-time processing. The models are trained to accurately classify aerial vehicles based on their size, shape, and flight characteristics.

The SDN controller is configured to analyze and process data from the sensors in real-time using the CNN model. The output of the CNN model is sent to the central server or agency via a VPN, where it can be further analyzed and acted upon.

Monitoring the SDN architecture is critical to ensure that it is functioning correctly. The SDN controller is configured to generate alerts if any sensors or switches fail or if there is any unusual activity detected in the network. Regular monitoring of the data transmitted from the SDN architecture allows for early detection of potential issues and prompt resolution.

In conclusion, the proposed solution using SDN technology and machine learning algorithms presents a promising approach to identifying and tracking aerial vehicles in real-time. The combination of SDN technology, strategically placed sensors, and the use of machine learning models, such as CNN, allows for accurate identification and tracking of aerial vehicles. The deployment of this solution can contribute to increased safety in areas where aerial vehicles operate, as well as enhanced situational awareness for authorities and security personnel.

**ADVANTAGES OF THIS APPROACH**

The combination of Software-Defined Networking (SDN) and Machine Learning (ML) offers significant advantages in the identification and tracking of aerial vehicles in real-time. SDN provides a flexible and programmable network architecture that enables the collection and analysis of large amounts of data from different types of sensors. Meanwhile, ML algorithms can process this data to accurately identify and track aerial vehicles based on their flight characteristics and other relevant factors.

The SDN architecture in this project was designed to include sensors such as radar, cameras, and acoustic sensors, which can detect and track aircraft and drones in real-time. These sensors were strategically placed to provide maximum coverage of the area, and the switches were configured to forward data to the SDN controller. The servers were configured to receive and process the data collected by the sensors.

The ML model used in this project was a Convolutional Neural Network (CNN). The CNN is a deep learning algorithm that has been proven to be highly effective in image and video recognition tasks. It was trained using data collected by the sensors during the deployment of the SDN architecture. The models were trained to accurately classify aircraft and drones based on their size, shape, and flight characteristics.

The combination of SDN and ML allowed for the real-time analysis of large amounts of data collected by the sensors. The SDN architecture was able to transmit the output of the CNN model securely to the central server or agency via a VPN. The SDN controller was configured to generate alerts if any sensors or switches fail, or if there is any unusual activity detected in the network.

Overall, the combined SDN and ML approach proved to be effective in identifying and tracking aerial vehicles in real-time. It provided a flexible and programmable network architecture that enabled the collection and analysis of large amounts of data from different types of sensors. Additionally, the CNN model accurately processed the data to identify and track aerial vehicles based on their flight characteristics, leading to reliable and accurate results.

**RESULTS**

The SDN architecture deployed for the identification and tracking of aerial vehicles in real-time using machine learning algorithms successfully achieved its objectives. The system was tested in a real-world environment, and the results were evaluated based on the accuracy of the identification, the speed of data transmission, and the reliability of the system.

The system was able to identify and track aircraft and drones with a high degree of accuracy. The CNN model was able to process the data in real-time and accurately classify the aerial vehicles based on their size, shape, and flight characteristics. The system was also able to differentiate between authorized and unauthorized aerial vehicles, allowing for immediate action to be taken in case of any unauthorized entry.

The speed of data transmission was also evaluated, and the system was able to transmit the data collected by the sensors to the central server or agency via a VPN in real-time. The data was securely transmitted, ensuring the privacy and confidentiality of the information.

The reliability of the system was also evaluated by monitoring the SDN architecture. The SDN controller was configured to generate alerts if any sensors or switches fail, or if there is any unusual activity detected in the network. The central server or agency was also able to monitor the data transmitted from the SDN architecture.

Overall, the SDN architecture deployed for the identification and tracking of aerial vehicles in real-time using machine learning algorithms was successful in achieving its objectives. The system was able to identify and track aerial vehicles with a high degree of accuracy, transmit the data in real-time, and ensure the reliability of the system. The system can be used in various applications, including military, aviation, and surveillance, to enhance security and safety.

**DISCUSSION**

The results of this study indicate that the proposed SDN-based system is effective in identifying and tracking aerial vehicles in real-time. The system successfully detected and tracked all types of aerial vehicles in various weather conditions. The use of a CNN model for analyzing and processing the data in real-time proved to be a suitable choice for this project.

One of the advantages of the SDN-based system is that it allows for the deployment of sensors in strategic locations to provide maximum coverage of the area. The configuration of the servers and switches allowed for the efficient forwarding of data from the sensors to the SDN controller, which was critical for real-time processing and analysis of the data.

The implementation of the CNN model in the SDN controller was successful in accurately classifying aerial vehicles based on their size, shape, and flight characteristics. The output of the CNN model was securely transmitted to the central server or agency via a VPN.

Monitoring the SDN architecture was critical for ensuring the system was functioning correctly. The SDN controller was configured to generate alerts if any sensors or switches failed, or if there was any unusual activity detected in the network. The ability to monitor the data transmitted from the SDN architecture was crucial for detecting and identifying any anomalies or security threats.

Overall, the proposed SDN-based system has significant potential for use in various applications related to aerial vehicle identification and tracking. Further research can focus on expanding the capabilities of the system, such as the integration of additional sensors or the use of more advanced machine learning models.

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