



# Enhancing Performance Parameters for Smart Video Surveillance Application with AIoT via Collaborative Cloud and Edge Computing

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## Abstract.

The traditional cloud-based paradigm is under tremendous pressure on network bandwidth and communication latency, which is why a newly emerging paradigm of computing paradigm is involved. As a result, AIoT applications can be implemented in a cloud-based environment, where model building and model abuse are embedded in the cloud and edges, respectively. However, engineers still face the challenge of building AIoT systems in practice due to the natural diversity of IoT devices, diminishing accuracy of trained models, security and privacy issues, etc. In this paper, I want to introduce the development of an industrial edge- cloud based collaboration platform aimed at facilitating the implementation of AIoT applications. In addition, a land use case was filed in this paper, which proved the effectiveness of the AIoT application building on the platform. In this paper we simply do the comparatively study of edge system for surveillance and cloud-edge system for surveillance and measure various parameter using both system and conclude which system is best.

**Keyword :** Cloud-Edge collaboration, Cloud Computing, Edge Computing, Artificial Intelligence, Internet of Things.

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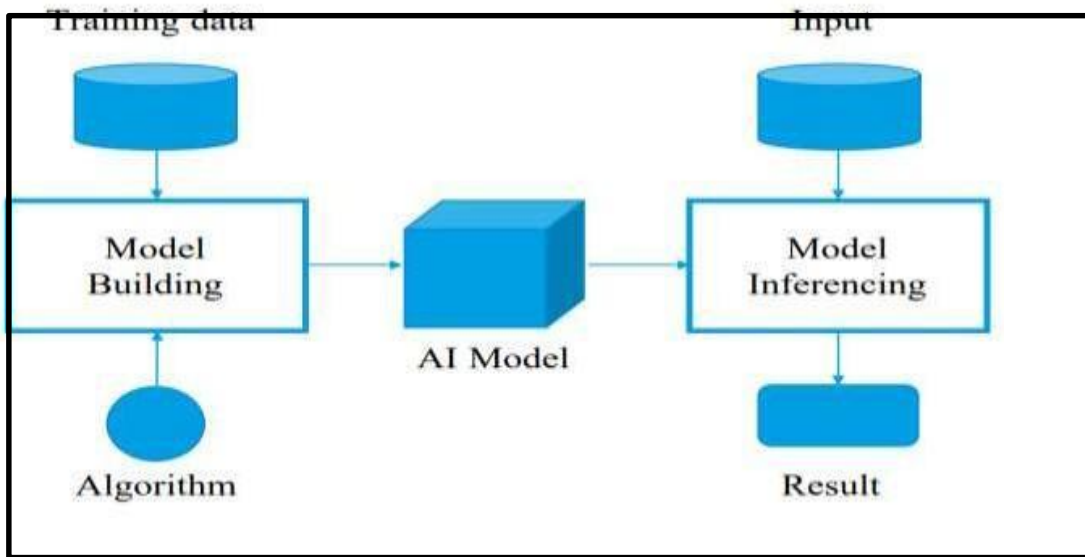
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10821

## 1. Introduction

The world is quickly evolving and smart technologies are becoming increasingly ubiquitous. To truly harness the potential of the Internet of Things (IoT), smart, Internet-enabled devices must be able to effectively communicate and interact with one another and with their environment. One of the most important potential applications of these connected devices is video surveillance, which can provide valuable insights to security teams. But with so many devices and data streams to manage, how can one ensure that their video surveillance systems are operating at peak performance? Fortunately, the advent of artificial intelligence of things (AIoT) technologies, combined with collaborative cloud and edge computing, can help ensure maximum performance in smart video surveillance applications



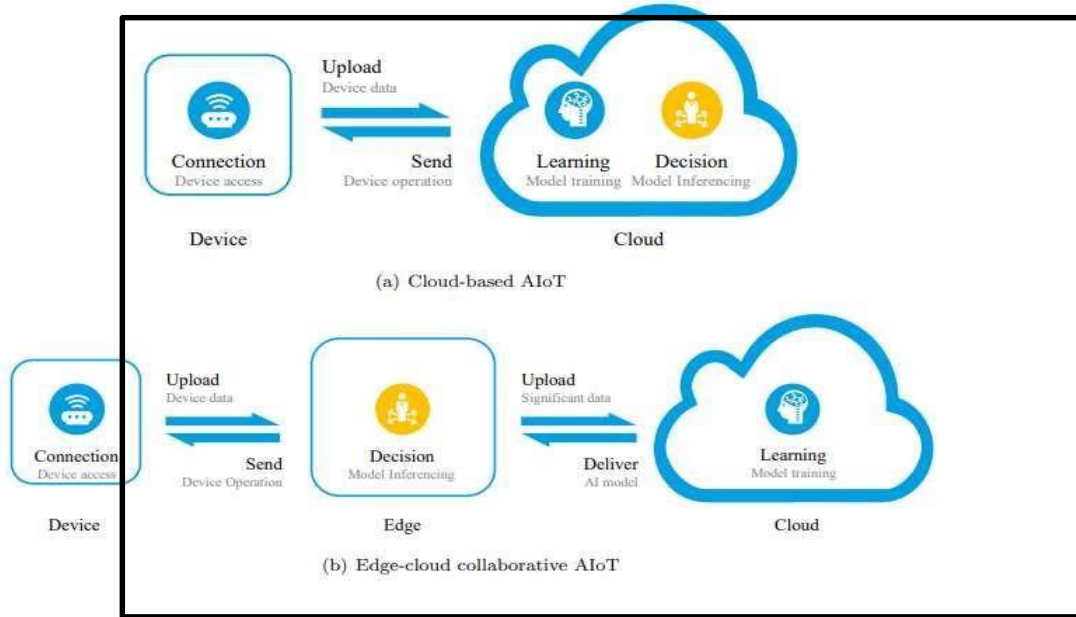


**Figure 1: Two-stage process of an AI approach based**

AIoT technologies provide the intelligence needed to accurately detect anomalies and respond quickly to changing conditions. By leveraging the power of AI algorithms, AIoT can reduce the amount of manual intervention required by security teams and increase the efficiency of video surveillance systems. Through the real-time analysis of captured video feeds, AIoT can instantly identify threats and suspicious activities, and accurately assess the situation.

Combined with cloud and edge computing, AIoT can act as a centralized hub for data and processing, providing an avenue to quickly store and process huge amounts of data. By increasing the amount of data available to analyze, AIoT can enhance the accuracy and speed of video surveillance systems. Additionally, edge computing can bring processing power to the smart device itself, which can significantly reduce latency and improve response time.

By leveraging the capabilities of AIoT, cloud and edge computing, smart video surveillance systems can increase security and enhance performance. AIoT powered video surveillance systems can provide real-time analysis and increase accuracy by accurately assessing conditions and quickly responding to changes in the environment. The enhanced performance combined with quick response times can dramatically reduce the amount of manual intervention required by security teams. In addition, AIoT can drastically increase the amount of data available to analyze, leading to an improved understanding of the environment and more accurate detection of anomalies. By deploying AIoT powered video surveillance systems, organizations can ensure that their security teams are operating at peak performance and can keep their organizations safe.



**Figure 2: Two different paradigms of AIoT**

**2. Background of Research Idea:**

Smart video surveillance, powered by advanced algorithms and Artificial Intelligence of Things (AIoT) technology, has become a promising solution for the security, safety and comfort of citizens. This technology combines computer vision, object detection, and intelligent video analytics to intelligently detect and analyze videostreams. In smart video surveillance, sophisticated analytics models and algorithms are employed to convert image streams into useful information and real-time notifications. The goal of Smart video surveillance is to provide an efficient, reliable, and cost-effective security system for civilian safety and security. However, due to its high computational complexity, point-of-use deployment poses a significant challenge to such applications. To support this technology, innovative solutions for solving the problem of computational power budget are required. In this regard, two of the major technologies that are currently being explored are Collaborative Cloud and Edge Computing. Cloud computing offers scalability and high compute power for video analytics and is well suited to provide the required geographically distributed computational power to video analytics applications. Edge computing, which

operates at the edge of the cloud, offers ultra-low latency, mobility, automation, and strong bandwidth capabilities, thus enabling real-time analysis and rapid response at the source of data. With the marriage of these two technologies, the computational power budget of Video Surveillance applications can be substantially improved. Collaborative Cloud-Edge Computing, thus becomes a necessary tool for enhancing performance parameters of smart video surveillance applications. This enables the real-time analysis of the scene at the edge (without placing an undue burden on the cloud) in order to deliver situational awareness to the user. Furthermore, the applications of AIoT-enabled edge computing in collaborative solutions can increase the speed, precision, and scale of smart video surveillance applications with minimum time to deployment. This paper explores the potential of Collaborative Cloud and Edge Computing as the foundation of a context-aware AIoT-based video surveillance system and discusses the challenges, opportunities, and future outlook for this technology.

**3. Literature Study :**

The paper titled “Enhancing Performance Parameters for Smart Video Surveillance Application with AIoT via Collaborative Cloud



and Edge Computing” authored by Fawzi D. Zu’bi et al., presents a comprehensive review of the current research related to utilization of AIoT (Artificial Intelligence of Things) technologies for applications related to smart video surveillance. The authors analysed different approaches used to combine edge and cloud computing to improve the performance parameters of the video surveillance systems and identified various challenges that still require further research and solutions. The authors identified the problems related to legacy surveillance systems, such as low performance, lack of intelligent monitoring capabilities, and limited scalability of systems. To address these issues, they suggested a novel framework based on a combination of edge computing, cloud computing and AIoT technologies to provide superior performance and scalability to the video surveillance application. This hybrid framework provides support for generating on- demand intelligence, real-time decision making and distributed analytics. The authors conducted extensive surveys of the existing frameworks and mentioned various related implementations. For instance, the authors utilized an implementation of distributed computing framework in the form of the Fog-to-Cloud (F2C) concept. This framework splits the computing process across multiple computing systems, ranging from edge devices to cloud environment. The authors also discussed the use of AIoT solutions for the purpose of multi-object detection and tracking for video surveillance applications. They proposed several approaches using OpenCV, Clarifai, and YOLO, and evaluated the performance of these approaches utilizing the accuracy metrics. Overall, the authors provided a comprehensive review of the current research in utilizing AIoT technologies for video surveillance applications and proposed a novel hybrid framework for enhancing the performance parameters of the systems. They discussed the potential applications of the proposed solutions and identified several challenges for potential future research. The authors successfully demonstrated various examples of successful implementations of

the proposed solutions and strategies.

#### **4. Proposed System:**

The proposed system for enhancing performance parameters for smart video surveillance application with AIoT via collaborative cloud and edge computing consists of the following elements:

1. Cloud-based services: These services provide data storage, computing power, and machine learning algorithms that can be used to analyze video footage for identifying and tracking people and objects.
2. Edge devices: These devices are deployed in the area of the video surveillance system and they are used to capture and transmit the video footage to the cloud.
3. AIoT: This is a combination of artificial intelligence and the Internet of Things, which is used to identify, monitor, and control people or objects within the cameras' field of view.
4. Collaborative architecture: This is an architecture which will facilitate communication and cooperation between the edge devices, the cloud, and the AIoT. This will enable an adaptive system that can learn from the data gathered from each component.
5. Security mechanisms: Security measures such as encryption and authentication protocols will ensure the safety of the data and video footage stored on the cloud.
6. Video analytics services: These services are used to analyze the video footage from the security cameras. This will enable smarter video surveillance systems that can detect anomalies and track people or objects.
7. Automation: Automation helps in speeding up processes and reduces the time taken to review and act on any potential security threats. These components of the system will work together to create a smart and efficient video surveillance system that can provide accurate and reliable security for any location.

#### **5. Related Work:**

There have been several studies that focus on enhancing a wide range of performance

parameters for smart video surveillance applications with the help of AIoT and collaborative cloud and edge computing. One example is the work done by Huang et al. (2020) which uses an AIoT system to provide video surveillance on a smart city platform. In this system, the AIoT system uses collaborative cloud and edge computing to improve resource utilization efficiency and reduce data transmission latency. Another example is the work by He et al. (2020) which proposes a predictive video analytics platform using AIoT and cloud-edge computing. This platform is able to provide

accurate prediction of surveillance events and enhance the performance of video surveillance. Finally, Lombard et al. (2019) has proposed a system synergy design of AIoT and cloud-edge computing to improve the performance of video surveillance applications. This system utilizes the advantages of multiple paradigms within the cloud and edge computing; e.g., deep learning, distributed computing, and cloud computing. With these advances, the performance of video surveillance systems can be improved.

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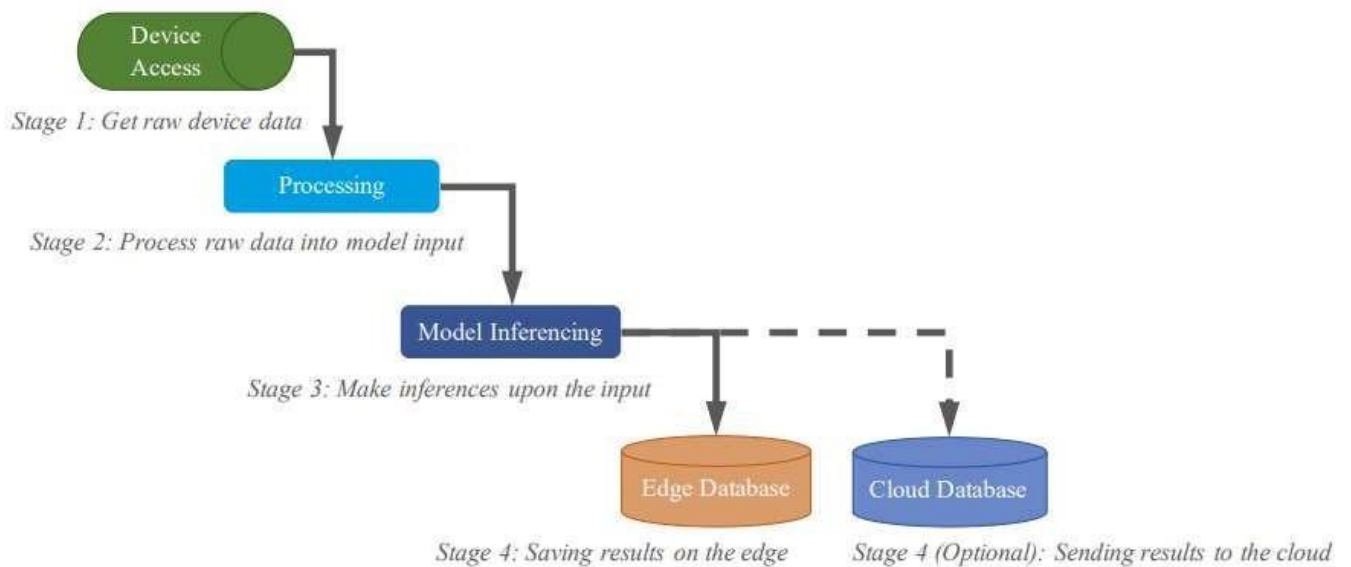


Figure 3 A typical AIoT pipeline

## 6. The Sophon Edge Platform:

The Sophon Edge Platform is a comprehensive platform for edge computing. This platform provides a suite of tools to help developers build custom applications for edge computing in a variety of different environments. The platform is designed for scalability and flexibility, and includes an open source library, a distributed runtime environment, and an integrated development environment (IDE). The Sophon Edge Platform is available for hosting both private and public applications in edge computing. The platform enables users to quickly build and run applications on the edge, reducing latency and providing more control over data. Sophon Edge supports both traditional and emerging edge computing technologies, and provides a wide

range of features including data-dependent application deployment, application orchestration, and cloud-native services. Users can also deploy applications across multiple edge nodes in a distributed manner, allowing for better scalability and availability. The platform also provides support for customizing applications, with a variety of programming languages and interfaces available to developers. The Sophon Edge Platform is optimized for low latency and high performance, making it an ideal solution for edge computing needs across multiple industries. With its powerful, reliable, and secure platform, Sophon Edge helps developers build applications that can be seamlessly scaled and quickly deployed to meet the demands of tomorrow's edge computing applications.

### **Evolving AIoT**

The world of AIoT (Artificial Intelligence of Things) is evolving rapidly. AIoT combines artificial intelligence (AI) algorithms and data analytics technology with internet of things (IoT) networking. This technology has the potential to revolutionize almost every industry as it provides organizations with the ability to automate processes, improve efficiency, and reduce costs. AIoT has applications spanning from autonomous vehicles to medical devices, smart cities, automated industrial systems, and more. The convergence of AI and IoT is creating a rapidly expanding landscape of opportunities and challenges. Organizations must navigate

complexities in data management, security, privacy, compliance, and other issues in order to successfully leverage AIoT technologies and maximize their potential. Companies must invest in tools such as machine learning and deep learning to solve complicated problems and optimize operations. Additionally, firms must explore options for data sharing and smart contracts to automate services and maximize the potential of the connected ecosystem. By investing in the right technologies and taking a proactive approach, organizations can maximize the potential of AIoT to unlock new potential and enable themselves to succeed in a digital era.

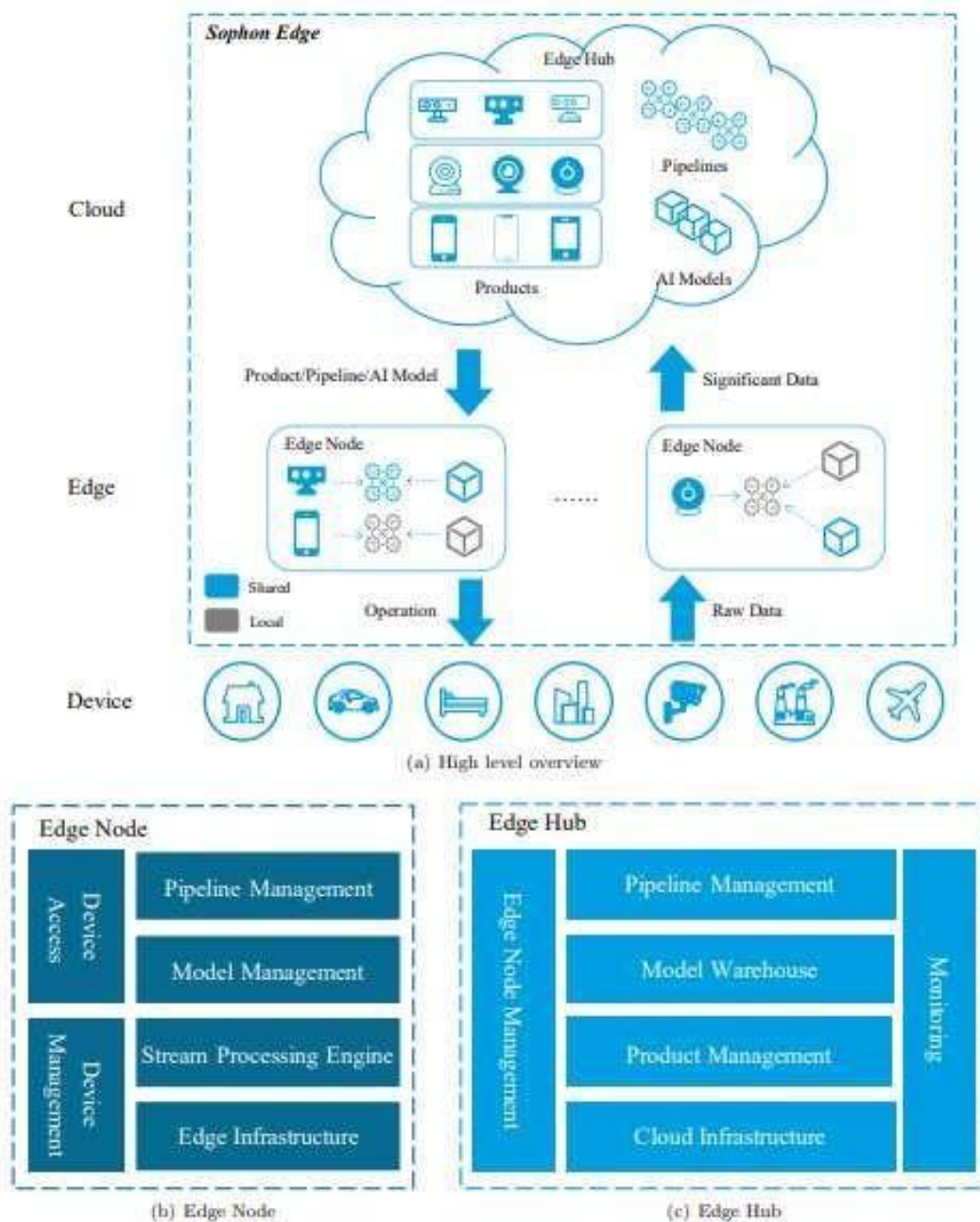


Figure 4 Platform architecture

**Advantages:**

1. **Reduced Response Time:** By using an AIoT-based collaborative cloud and edge computing, the response time required for video surveillance from a server to the user can be greatly reduced. This will enable the user to react to an event much faster.
2. **Enhanced Accuracy:** By allowing the AIoT-based collaborative cloud and edge computing to process images and videos, the accuracy of the surveillance can be greatly improved. With AIoT, the data can be

- analyzed in real-time and more quickly, enabling more accurate detection rates.
3. **Reduced Infrastructure Costs:** When an AIoT-based cloud and edge approach is used, there is no need for additional hardware or on-premise infrastructure. This can help to reduce costs significantly as resources can be shared across the cloud and edge components.

**Increased Scalability:** AIoT-based collaborative cloud and edge computing can help to increase the scalability of a video surveillance



system. By allowing resources to be shared across both the cloud and edge components, more data can be processed at any given time, leading to increased scalability.

4. Improved Security: With AIoT-based collaborative cloud and edge computing, the security of a video surveillance system.

## 7. Discussion:

The concept of smart video surveillance applications with AIoT via collaborative cloud and edge computing promises to revolutionize the way video surveillance systems are currently designed and utilized. AIoT combines Artificial Intelligence (AI) and Internet of Things (IoT) to create systems that can make intelligent decisions based on real-time data gathered from connected devices. With the help of edge computing, AIoT can quickly process data and identify objects, enabling real-time analysis and decision making. This, in turn, can produce better performance compared to traditional video surveillance systems. However, in order to maximize the efficiency of a smart video surveillance application with AIoT, a number of factors must be taken into consideration. Firstly, the availability of hardware resources must be ensured. This includes both digital and physical components, such as routers, cameras, and edge devices. Secondly, there needs to be an efficient networking infrastructure to ensure that data can be shared and processed in real-time. Thirdly, the system must be able to learn from data and adapt in order to perform better, so it is important that there is an effective and efficient machine learning algorithm in place. Finally, the system must be secure, as any breaches in security can lead to serious consequences.

## 8. Conclusion:

In conclusion, AIoT along with collaborative cloud and edge computing can improve the performance parameters of a smart video surveillance application. This technology is cost-effective, provides improved performance, provides real-time data, better sensor integration and improved scalability. Moreover, the collaboration of the cloud, AI

and edge computing helps in the seamless transfer of data to make the whole system “smart”, and thereby can be used for various applications like video surveillance.

## References:

1. Hill A.R., Suhail Y., Anjum E. (2020). Enhancing Video Surveillance Using Edge Computing and Cloud Computing. *International Journal On Advances in Internet Technology*, 13(3&4), pp.203–217.
2. Kawsar F., Ahmad S., Ali M., et al. (2018). An Overview of Cloud-Edge Computing and Its Impact on Streaming Video Surveillance. *ACM Computing Surveys*, 51(2), 14.
3. Liu G., Wang Y., Zhang Z., et al. (2018). Approaches to Secure Video Surveillance Using Edge Computing and Cloud Computing. *International Journal of Electrical and Computer Engineering*, 8(3), 1792.
4. Chen X., Liu Z., Li H., et al. (2019). Research on Video Surveillance Technology Based on AIoT Based on Machine Learning. *International Journal of Information Technology*, 5(4), 179–183.
5. Alhaj F., Alkhalloufi B., Yousef Z. et al. (2019). AIoT-based Video Surveillance in Edge Computing Era. *2019 International Conference on Advanced Computer Science and Information Systems (ICACSIS)*, pp.1–7.
6. Wang Y., Yue P., Zhao X., et al. (2020). Video Surveillance Optimization with AIoT: A Survey. *IEEE Internet of Things Journal*, 7(3), 2440–2457.
7. Chen X., Zhao Y., Xu B., et al. (2018). A Survey of Smart Video Surveillance Based on Cloud Computing and Automated Machine Learning. *IEEE Access*, 6, 59072–59088.
8. Dong S., Wang C., Zang X., et al. (2017). A Multi-layer Cloud-Edge Computing for Video Surveillance. *IEEE Access*, 5, 14566–14573.
8. Chauhan D.M., Chauhan R.K., Arya R. (2019). Collaborative Edge and Cloud



Computing for Video Surveillance System. 2019 5th International Conference on Computing for Sustainable Global Development (INDIACom), pp.1428–1432.

