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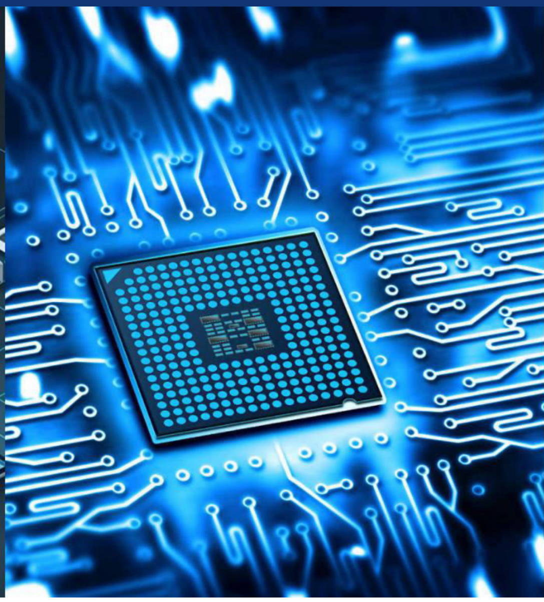

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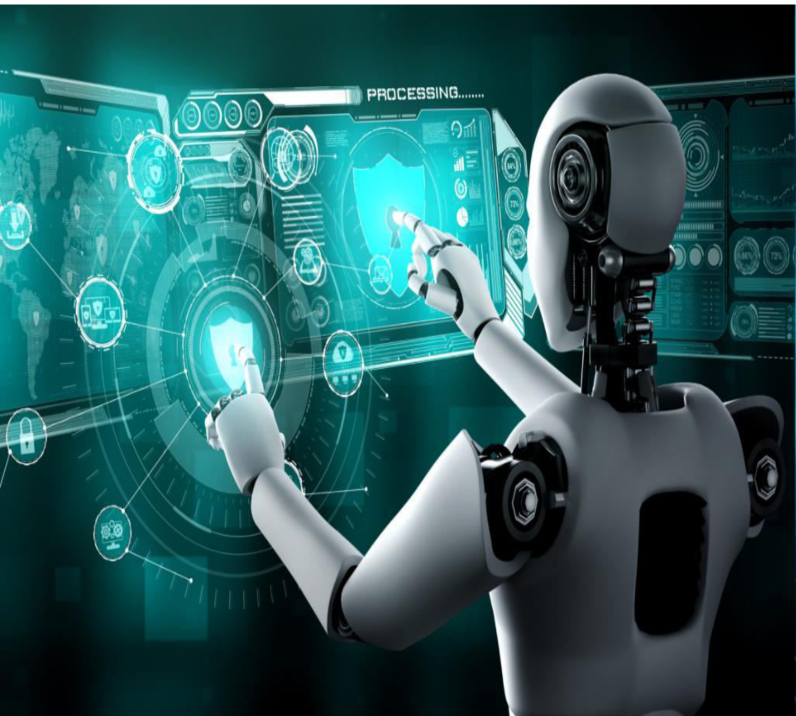

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Bee-Eye Inspired Privacy Preserving Video Coding

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ABSTRACT: An unprecedented amount of visual data is being collected, transmitted, and processed as a result of the quick development of artificial intelligence (AI)-driven video intelligence applications. These applications include medical diagnostics, driverless cars, smart cities, and smart surveillance, where visual analytics are essential for making decisions. However, ethical quandaries, identity leaks, and illegal access have given rise to privacy problems. Conventional approaches like face blurring, anonymization, and encryption-based security measures can result in computational inefficiencies or deteriorate video quality. A biologically inspired strategy for privacy-preserving video intelligence applications is put forth, emulating the bionic vision system of the bee eye.

KEYWORDS: Unprecedented, diagnostics, surveillance, ethical quandaries, anonymization.

I. INTRODUCTION

Bees use their complex eyes, which are made up of several ommatidia, to see the world. These eyes capture partially processed and fragmented visual information. Using this idea in conjunction with compressed sensing (CS), it is feasible to create a low complicated yet incredibly efficient method of video coding that protects anonymity. As more and more industries rely on video intelligence applications, protecting privacy while preserving effective data processing has grown to be a major concern. Conventional privacy-preserving methods like anonymization and encryption add computing complexity and could reduce the usefulness of the video data. This study investigates a novel Visual Privacy-Preserving Coding (VPPC) technique that uses Compressed Sensing (CS) to secure visual data while enabling real-time video analysis. It is inspired by the compound eye structure of bees.

The multifaceted vision system of the bee eye, which was inspired by nature, provides an effective method of selectively obscuring visual details while preserving important scene information. This approach guarantees privacy preservation by incorporating compressed sensing (CS) without the need for extra encryption layers or large computational resources.

This study investigates a bio-inspired visual privacy-preserving coding system that uses Compressed Sensing (CS) to selectively encode video frames, drawing inspiration from the compound eye anatomy of bees. Sensitive information is kept hidden while yet allowing for crucial analytics by using a low-resolution, fragmented depiction of the visual landscape, much like bees see their surroundings. The difficulty is in creating a real-time, effective framework for video coding that protects privacy without compromising the functionality of AI-powered video analytics tools.

II. LITERATURE SURVEY

The Intelligent video surveillance systems are useful for identifying unusual events in the house, like attacks and falls. However, in order to fully recognize behaviour, standard video surveillance systems require clear and complete video data. There is a lot of privacy-sensitive information in the home setting. This information poses a major risk to personal privacy if it is stolen and used improperly by others [1].

The Haptics is crucial to both artificial robotic hands and human hands' ability to grab and manipulate items. At the tips of the fingers, there is an extremely high density of touch receptors—140 units/cm2. Nevertheless, the current tactile sensor density is extremely low. This article suggests a unique high-density arrayed and curved 3-D tactile sensor based on bionic compound eye that can have a density of up to 42 units/cm2 in order to increase the density[2]. The challenge to complete a flying assignment with obstacle avoidance and target tracking concurrently using a micro unmanned aerial vehicle (UAV) that is just outfitted with a monocular camera. To avoid obstacles, a bio-inspired

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optical flow balance algorithm and an enhanced bat algorithm (BA) were integrated with an efficient transfer learning convolutional neural network (CNN). For UAV dynamic tracking with obstacle avoidance, the Hawk-eye algorithm with line of sight (LOS) tracking criteria is used[3].

Multiwind disturbances in probe-and-drogue autonomous aerial refueling (AAR) docking result in low receiver position control and drogue relative location estimation accuracy. In order to support the success of probe-and-drogue AAR docking, this paper further develops an AAR outfield experiment platform and suggests a bionic visual navigation control system in a hardware-in-loop simulation environment. The biological approach mimics the eagle-eye color vision system to detect the drogue region and markers[4].

A bionic artificial compound eye imaging system that uses MEMS manufacturing and quantum dots doped film. The device integrates a micro-lens array and bionic organic photodetector at the microscale, meeting the requirements of large curvature bending and ultrathin flexibility. Significant discriminative sensitivity to various target shapes and light sources is demonstrated by biomimetic eye pixels[5].

The blindness is a terrible condition that can be brought on by retinitis pigmentosa (RP) and numerous other age-related macular degenerations (AMD). A person with this type of sickness loses their ability to see because the photoreceptor cells in their retina deteriorate and cause damage. Therefore, by restoring vision, the bionic eye performs a crucial role. The MIT HARVARD device, ARGUS II, artificial silicon retina system (ASR), and multiple unit artificial retina chip system (MARC) are among the technologies used in bionic eyes[6].

III.ARCHITECTURE OF THE SYSTEM

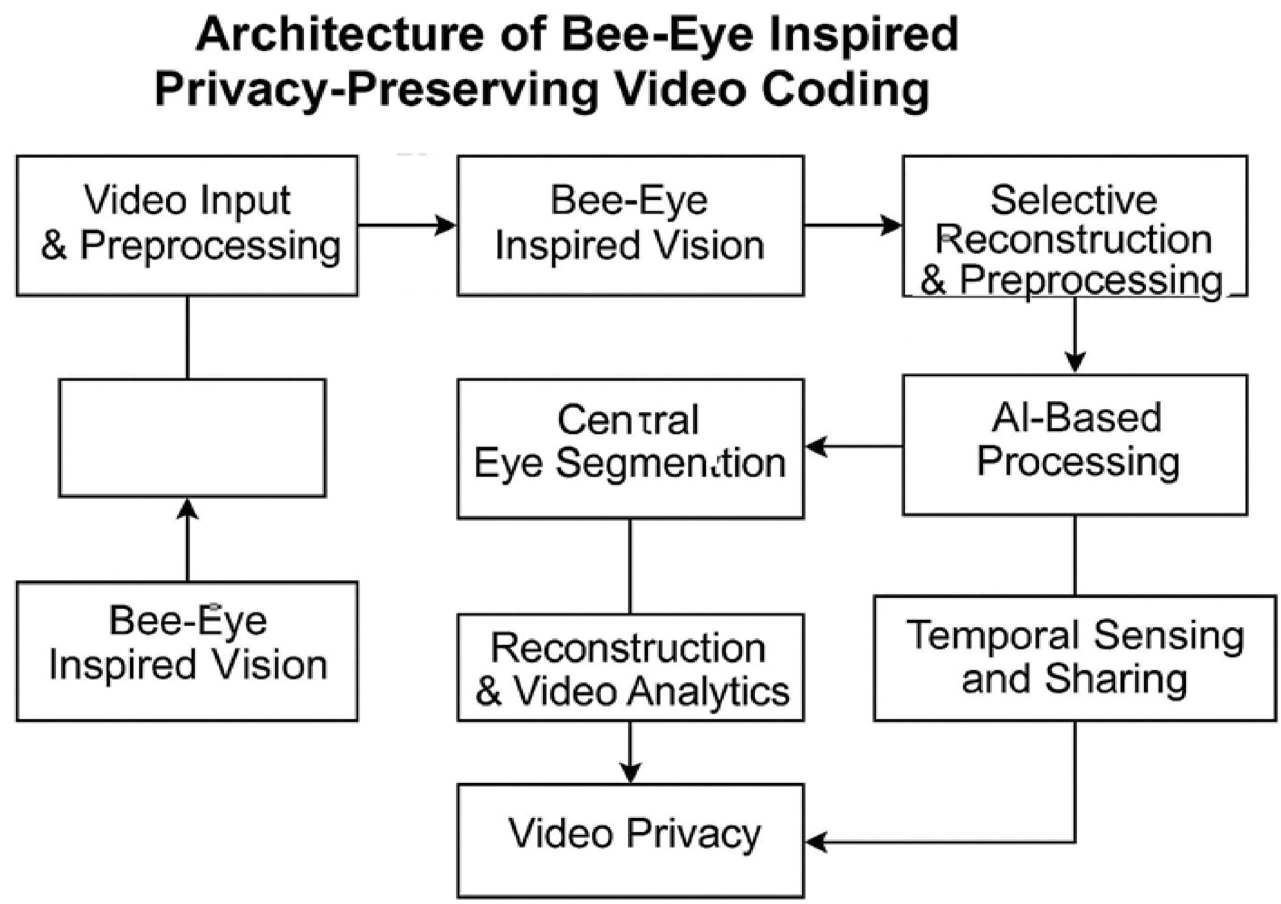

Figure 3.1.1 Block diagram for Bee Eye Inspired Privacy preserving video coding

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The proposed Visual Privacy-Preserving Coding (VPPC) framework uses compressed sensing (CS) and bio-inspired vision to address privacy preservation issues in video intelligence applications. Conventional techniques, such encryption and anonymization, are inappropriate for real-time applications because they frequently increase computational cost or deteriorate video quality. The compound vision system of the bee eye, which records visual information in a low-resolution, fragmented fashion and permits selective data processing while maintaining privacy, serves as the model for this study. The framework effectively compresses video data by incorporating Compressed Sensing (CS), which lowers storage expenses, transmission costs, and privacy threats.

Flow Algorithm

By using a systematic, multi-stage process, the Bee Eye-Inspired Privacy-Preserving Video Coding System improves privacy protection while facilitating behaviour detection. The method starts with the input video, where several frames that depict various human movements—like sitting, walking, or falling—are taken in order to process them further. A bionic coding method based on compressed sensing is used to convert human vision data into a vision model inspired by bees in order to preserve privacy.

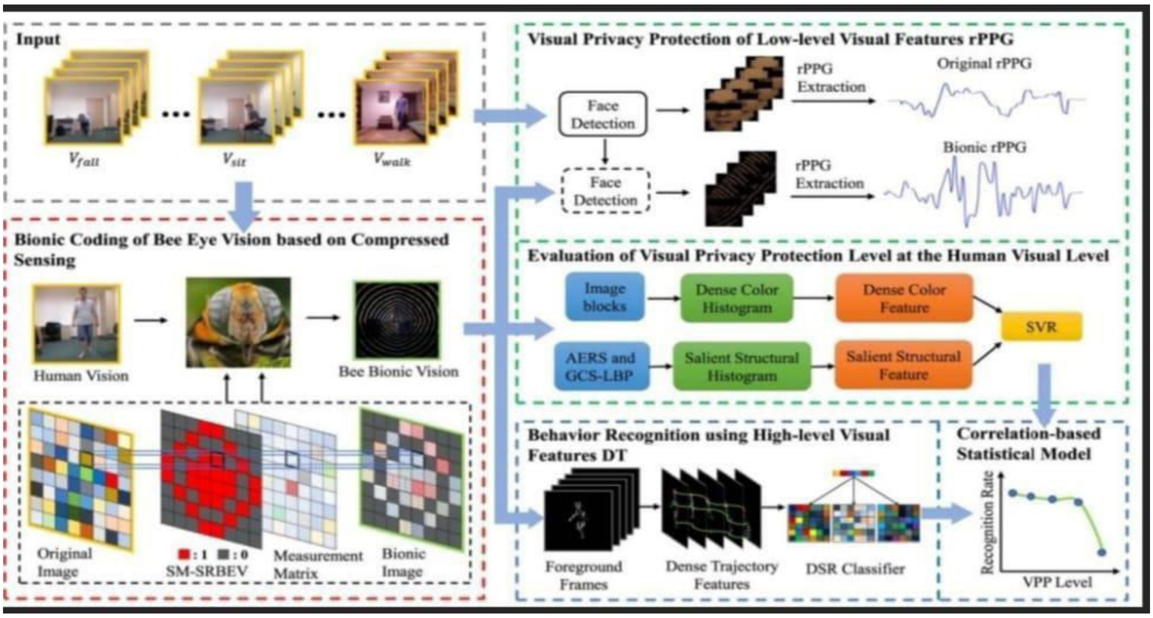

Figure 3.2.1 Flow Chat of Bee-Eye

A Bee-Eye Inspired Privacy-Preserving Video Coding System that uses AI-based analytics and compressed sensing to guarantee security and privacy in video processing is depicted in the flow diagram. The first thing the system does is record live video frames of various motions, such walking, sitting, and falling. Before being converted into bee bionic vision—a method modelled after the complex eyes of bees—these frames go through preprocessing. In order to obscure distinguishable details while maintaining crucial structural information, the video is compressed into patches using compressed sensing (CS) and encoded using a measurement matrix. This technique greatly improves privacy because it makes it very difficult for unauthorized parties to recreate private information.

A correlation-based statistical model assesses the trade-off between privacy protection and recognition accuracy, while a Dynamic Sparse Representation (DSR) classifier aids in behaviour identification while preserving privacy. This guarantees that analytics powered by AI can continue to tasks like as behaviour identification, motion tracking, and anomaly detection—even when privacy- preserving modifications are used. All things considered, this bio-inspired video coding system offers a novel method of privacy-conscious video processing, which makes it ideal for use in security, smart surveillance, and medical monitoring applications. The solution guarantees data protection, lower bandwidth/storage requirements, and efficient video analytics without sacrificing privacy by combining compressed sensing, biological vision principles, and AI-driven analytics.

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IV. RESULTS AND NOVEL CONTRIBUTION

The results of the suggested Visual Privacy-Preserving Coding (VPPC) framework, which combines compressed sensing (CS) and fragmentation modeled after bee eyes, are shown in this chapter.To improve privacy in applications that use video intelligence. Reconstruction accuracy, computing efficiency, bandwidth reduction, and privacy protection efficacy are all evaluated experimentally.Furthermore, this study's innovative contributions are emphasized, demonstrating its improvements over current privacy-preserving techniques.

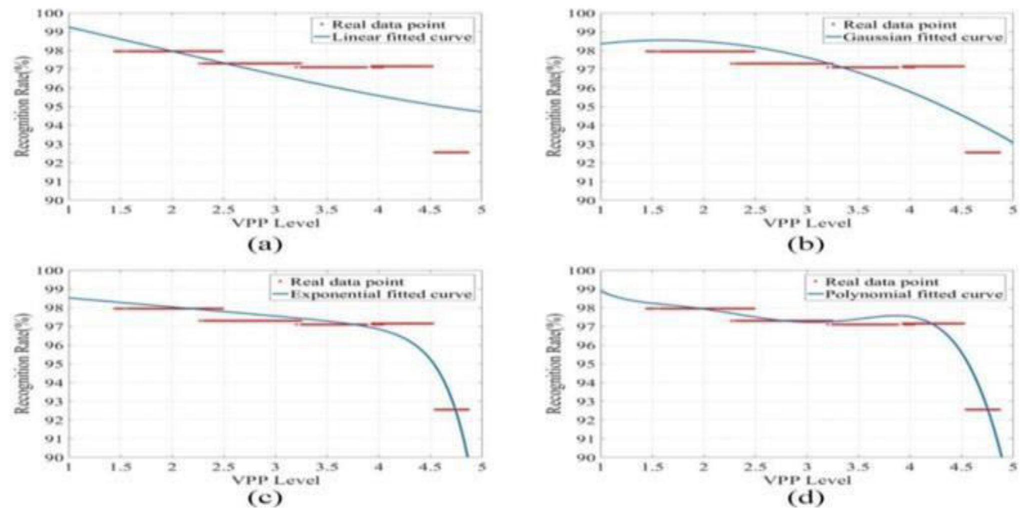

TABLE 4.1 Results of fitting between VPP levels and the behavior recognition rates of BCBEV-CS

The modeling results above allow us to make the following deductions: The recognition rate started to rapidly decline when the BCBEV-CS model's sampling rate was less than 22%, meaning that the VPP level was higher than 4. When the sampling rate was less than 18%, the recognition rate fell to lower values that were still insufficient for intelligent applications. Furthermore, the VPP level was less than 4 when the sample rate exceeded 22%, which does not satisfy the VPP's requirements. Thus, in order to attain a suitable balance between the VPP level and the recognition rate, we selected BCBEV-CS data with a sampling rate of 18% to 22%. Sequences were extracted from the foreground frames of the BCBEV CS films using the low-rank sparse decomposition technique. Figure 9 shows the frames. The foreground target could still be recovered even when coding at a low sampling rate. Second, the foreground movies' DT features (96 dimensions for HOG, 108 dimensions for HOF, and 192 dimensions for MBH) were taken out and then fuzed using PCA.

V. CONCLUSION

This study presented a bio-inspired Visual Privacy-Preserving Coding (VPPC) architecture for video intelligence applications. It makes use of compressed sensing (CS) and fragmentation inspired by bee eyes. The suggested method provides real-time, computationally effective, and bandwidth-saving privacy protection, effectively addressing the drawbacks of conventional privacy-preserving techniques. Bee-eye-inspired fragmentation and CS encoding keep sensitive information hidden. Real-time processing is made possible by low computational overhead, which is 5× faster than encryption-based techniques. It is perfect for cloud and edge computing due to its storage and bandwidth efficiency, which can cut data sizes by up to 65%.

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