

## VIDEO DATA FOR TRANSMISSION IN TV CHANNELS

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Intelligent analysis of video data encompasses a variety of techniques, including machine learning, deep learning, computer vision, and real-time processing. These methods are designed to automate the detection, categorization, and enhancement of video content, ensuring seamless transmission and high-quality viewing experiences. For instance, deep learning models, such as convolutional neural networks (CNNs) and long short-term memory (LSTM) networks, are extensively used for content recognition and anomaly detection in video streams[1].

Moreover, the integration of real-time processing capabilities allows for the immediate analysis and transmission of video data, which is crucial for live broadcasts and time-sensitive content. Techniques such as spatio-temporal texture modeling and real-time violence detection frameworks have demonstrated significant potential in maintaining the integrity and responsiveness of video streams during live events.

In addition to improving video quality and transmission efficiency, intelligent analysis methods also play a critical role in ensuring the security and privacy of video data. Advanced encryption techniques and privacy-preserving analysis methods are increasingly being implemented to safeguard video content from unauthorized access and tampering[2].

This review paper aims to provide a comprehensive overview of the current methods used in intelligent video data analysis for television transmission. It explores the various categories of techniques, including machine learning, deep learning, computer vision, compression algorithms, and real-time processing. By examining the advantages, limitations, and practical applications of these methods, this paper seeks to highlight the state-of-the-art developments in this field and identify future research directions to further enhance the capabilities of video data analysis in television broadcasting.

### **Overview of Video Data Analysis in Television Transmission**

The analysis and transmission of video data have evolved significantly over the years, driven by advancements in digital technology and increasing demands for higher quality and more efficient broadcasting. Initially, video data transmission relied on analog methods, which had limitations in terms of quality, efficiency, and scalability. The shift to digital broadcasting marked a significant improvement, allowing for better compression, error correction, and overall quality of video content.

Digital broadcasting introduced the use of various compression algorithms, such as MPEG-2 and H.264, which enabled the efficient transmission of high-quality video over limited bandwidth. The introduction of high-definition (HD) and, more recently, ultra-high-definition (UHD) television has further pushed the boundaries of video quality and necessitated more sophisticated methods for video analysis and transmission[3]. Table 1.[4] provides an overview of the main characteristics of images in HDTV, 4K and 8K UHD TV.

**Table 1.** The characteristics of different digital TV formats.

	<b>HDTV</b>	<b>4K UHD TV</b>	<b>8K UHD TV</b>
<b>Pixels × number of lines</b>	1280 × 720 p 1440 × 1080 i 1920 × 1080 p(i)	3840 × 2160	7680 × 4320
<b>Mpixels/frame</b>	0.922 1.6 2.1	8.3 Progressive	33.2 Progressive
<b>Aspect ratio</b>	16:9	16:9	16:9
<b>Frame rate</b>	25, 50, ... fps 30 fps +24 fps	25, 50, ... fps 30, 60, 120 fps +24 fps	25, 50, ... fps 30, 60, 120 fps +24 fps
<b>Bit depth</b>	8 or 10 bits	10 or 12 bits	10 or 12 bits
<b>Viewing distance</b>	3 × H (30°)	1.5 × H (60°)	0.75 × H (100°)

### Current Trends and Technologies

In the current landscape, the integration of intelligent analysis methods into video data transmission processes is becoming increasingly prevalent. These methods are primarily driven by advancements in machine learning, deep learning, and computer vision technologies. The main trends include:

**Machine Learning and Deep Learning:** These techniques are extensively used for tasks such as content recognition, anomaly detection, and automatic feature extraction. Deep learning models, such as convolutional neural networks (CNNs) and long short-term memory (LSTM) networks, are particularly effective in analyzing video data due to their ability to learn complex patterns and representations from large datasets.

**Real-time Processing:** The demand for real-time video analysis has led to the development of frameworks that can process video streams with minimal latency. Techniques like spatio-temporal texture modeling and the use of Apache Spark for big data processing have enabled the real-time detection of events and anomalies in video streams.

**Compression Algorithms:** Modern compression techniques, such as H.265 (HEVC), offer improved compression efficiency compared to their predecessors. These algorithms reduce the amount of data needed to transmit high-quality video, making it possible to deliver UHD content over existing bandwidth constraints.

**Security and Privacy:** Ensuring the security and privacy of video data during transmission is critical. Techniques such as encryption and privacy-preserving machine learning models are employed to protect video content from unauthorized access and to comply with regulatory requirements[2].

#### Analysis of surveillance videos: current relevance

The main objectives identified which illustrate the relevance of the topic are listed out below.

1. Continuous monitoring of videos is difficult and tiresome for humans.
2. Intelligent surveillance video analysis is a solution to laborious human task.
3. Intelligence should be visible in all real world scenarios.
4. Maximum accuracy is needed in object identification and action recognition.
5. Tasks like crowd analysis are still needs lot of improvement.

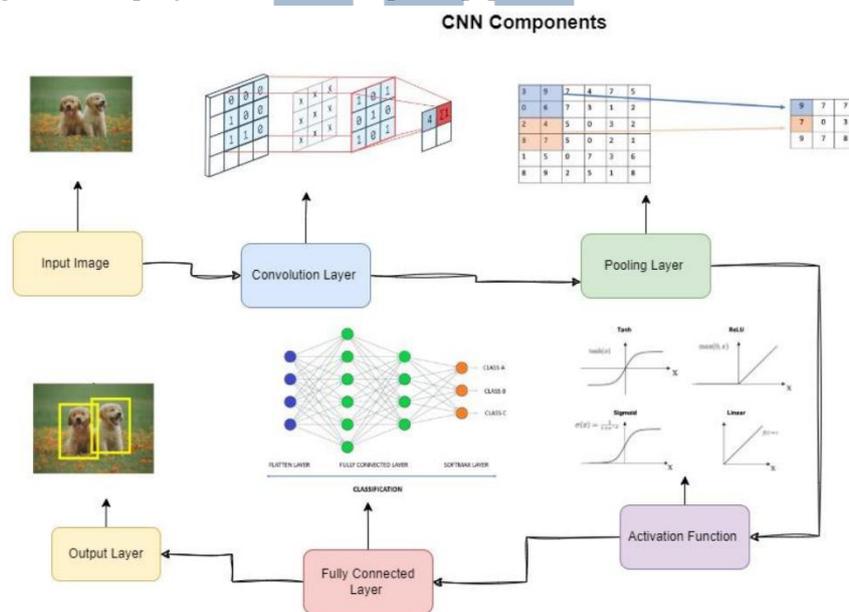
6. Time taken for response generation is highly important in real world situation.
7. Prediction of certain movement or action or violence is highly useful in emergency situation like stampede.
8. Availability of huge data in video forms.

**Categories of Intelligent Analysis Methods**

**Machine Learning and Deep Learning**

Machine learning and deep learning methods are at the forefront of intelligent video analysis. These techniques include:

**Convolutional Neural Networks (CNNs):** Used for image and video recognition tasks, CNNs can automatically detect and classify objects within video frames. They are particularly useful for applications such as facial recognition and content-based video retrieval. This network is frequently used in visual identification, medical image analysis, image segmentation, NLP, and many other applications since it is specifically designed to deal with a range of 2D shapes[5]. It is more effective than a regular network since it can automatically identify key elements from the input without the need for human participation. Understanding the various CNN components and their applications is critical to comprehending the advancements in CNN architecture. Figure 1 displays several CNN parts[6].



**Figure 1.** The CNN Components.

**Recurrent Neural Networks (RNNs) and LSTMs:** These models are adept at handling sequential data, making them ideal for analyzing video streams where temporal context is crucial. LSTMs are commonly used for tasks such as activity recognition and anomaly detection in video sequences[7].

**Computer Vision Techniques**

Computer vision techniques focus on extracting meaningful information from video data. Key methods include:

**Object Detection and Tracking:** Techniques like YOLO (You Only Look Once) and SSD (Single Shot MultiBox Detector) enable real-time detection and tracking of objects within video frames, which is essential for applications such as surveillance and automated content tagging.

Object detection is a fundamental task in computer vision, involving the identification and localization of objects within an image or video frame. It is crucial for various applications,

including surveillance, autonomous driving, and video indexing. Some popular object detection algorithms and frameworks include.

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