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ANALYSIS OF THE TRANSMISSION MODELS USED IN VIDEO STREAMING AND THE VIDEO ENCODING SYSTEMS MOST COMMONLY USED IN THE TRANSMISSION OF CONTENT

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Abstract
A systematic review was carried out on the production and publication of research papers on the study of Transmission Models, Video Streaming Coding Systems, under the PRISMA approach (Preferred Reporting Items for Systematic reviews and Meta-Analyses). The purpose of the analysis proposed in this document is to know the main characteristics of the publications registered in the Scopus and WoS databases during the year and their scope in the study of the proposed variables, achieving the identification of 132 publications. Thanks to this first identification, it was possible to refine the results through the keywords entered in the search button of both platforms, which were BROADCASTING MODELS, VIDEO STREAMING CODING SYSTEMS, reaching a total of 20 documents, already excluding duplicates and those that did not meet the analysis criteria. The identified scientific publications were analyzed in the hope of finding out the relationship between the variables, as well as the transmission models most frequently used in real-time video streaming.

Keywords: Transmission Models, Streaming Video Encoding Systems.

INTRODUCTION

The consumption of audiovisual material has evolved as technological advances have allowed it. Currently, the global trend has marked the success of streaming transmission, leaving aside the use of conventional television. Streaming transmission is part of the digital multimedia distribution technology that encompasses many aspects or most of the Information and Communication Technologies (ICT) in it. This means that the reproduction of videos with the support of technological devices, is done through tools such as Smart Tv, Computers, Electronic Tablets, and Smart Phones, among others, which are connected to the Internet, can play videos of short, medium or long duration, with a quality that depends on factors inherent to the web, such as download speed, upload

speed, device capacity, among others, presenting the option to record, rewind, fast forward, pause, which are features that are not found in traditional television (Velarde, 2018). However, the main characteristic of Streaming lies in the possibility of visualizing content uploaded to the Internet, without the need to download it to the internal memory of the devices, which saves storage space since they are reproduced in real-time. For this to be possible, it is necessary to have the UDP and TCP protocols which improve the data transmission process presenting many benefits such as the case of sending continuous packets without having a flow control (Table 1).

PROTOCOL	
TCP	**UDP**
Focused on the security of both sent and received packets	Gives a higher speed in transmission than security
It is based on methods such as control and validation of package information.	It does not include processes for the control and validation of package information.
It avoids the information that contains errors in the transmission to ensure the quality of the transmission.	Since it does not have a verification and control system, it is used in streaming transmission since it does not require downloading to the device storage.

TABLE 1. TCP AND UDP PROTOCOLS

Source: Own elaboration, based on the study entitled " Implementing an IP PBX based on Open-Source Technology in the Computer Systems Engineering Career" (ARBOLEDA, 2015).

The transmission of the content offered on the Web may or may not be controlled, depending on the protocols established by the content provider, which can be OTT or IPTV. In the first group are those who cannot control the audiovisual content or its distribution in their service, while in the second group are those who deliver content only from their structure limiting the user to consume it (Table 2).

COMPARATIVE BETWEEN OCT AND IPTV		
	OTT	**IPTV**
Content Delivery	Users use the Internet without direct management, as an "open ecosystem". Users have unrestricted access to applications and content.	Users use dedicated and optimized networks for this type of delivery where the operator controls the applications, and the content and performs the appropriate restrictions.
Type of network	Delivery by the content provider to the viewer uses open networks.	Delivery occurs over closed, proprietary networks, accessible only by a specific service provider.
Network ownership	There is no additional need for negotiation of delivery rules or at the infrastructure level.	Services are optimized and tailored to fit the network and capacity of the receiving equipment.
Quality of Service (QoS)	Not guaranteed, generally works under 'best-effort' conditions.	Enables control over the quality of content delivery.
Examples	VoD services: YouTube, Netflix or Hulu.	Imagenio or Orange TV services.
Protocols	HTTP (TCP) is mainly used as the transport protocol. There are also adaptive streaming technologies such as HLS (Apple) or HDS (Adobe). Content is delivered under UDP in combination with FEC connection protocols.	Traditionally IPTV uses TS (Transport Stream) as transmission technology. Content is delivered under UDP in combination with FEC connection protocols.

TABLE 2. COMPARISON BETWEEN OTT AND IPTV

Source: https://ispspeedindex.netflix.com/country/ecuador/#
Prepared by: Netflix (Velarde, 2018).

The above allows knowing how the contents are distributed through the web, and how technology has facilitated access to them. For this reason, the present research has been proposed, to know the impact that scientific research has generated in the study of the transmission models used in video streaming, as well as the most used coding systems. Therefore, the analysis of the research identified through the Scopus and WoS databases, published during the period between 2017 and 2021 is presented to know the position of the main authors and build an important theoretical basis that can support the generation of new knowledge in this regard, in future research.

GENERAL OBJECTIVE

To analyze from a bibliographic perspective, the production of high-impact research papers indexed in WoS and Scopus databases, on the variables Streaming Transmission Models and Coding Systems, based on the PRISMA methodology.

METHODOLOGY

The present research is qualitative, and according to Hernández et al. (2015), Qualitative approaches correspond to research that conduct the procedure of obtaining information to review and interpret the results obtained in such studies. For this purpose, a search for information was carried out in the Scopus and WoS databases using the words "TRANSMISSION MODELS" and "VIDEO STREAMING CODING SYSTEMS"

RESEARCH DESIGN

The research design proposed for this study was the Systematic Review which involves a set of guidelines to carry out the analysis of the data collected, which are framed in a process that began with the codification until the visualization of theories (Strauss & Corbin, 2016). On the other hand, the text corresponds to a descriptive narrative because it is intended to find out how the levels of the variable affect. It is also systematic because after reviewing the academic material obtained from scientific journals, the theories on knowledge management were analyzed and interpreted (Hernández, Baptista, & Fernández, 2015).
The results of this search are processed as shown in Figure 1, which expresses the PRISMA technique for the identification of documentary analysis material.

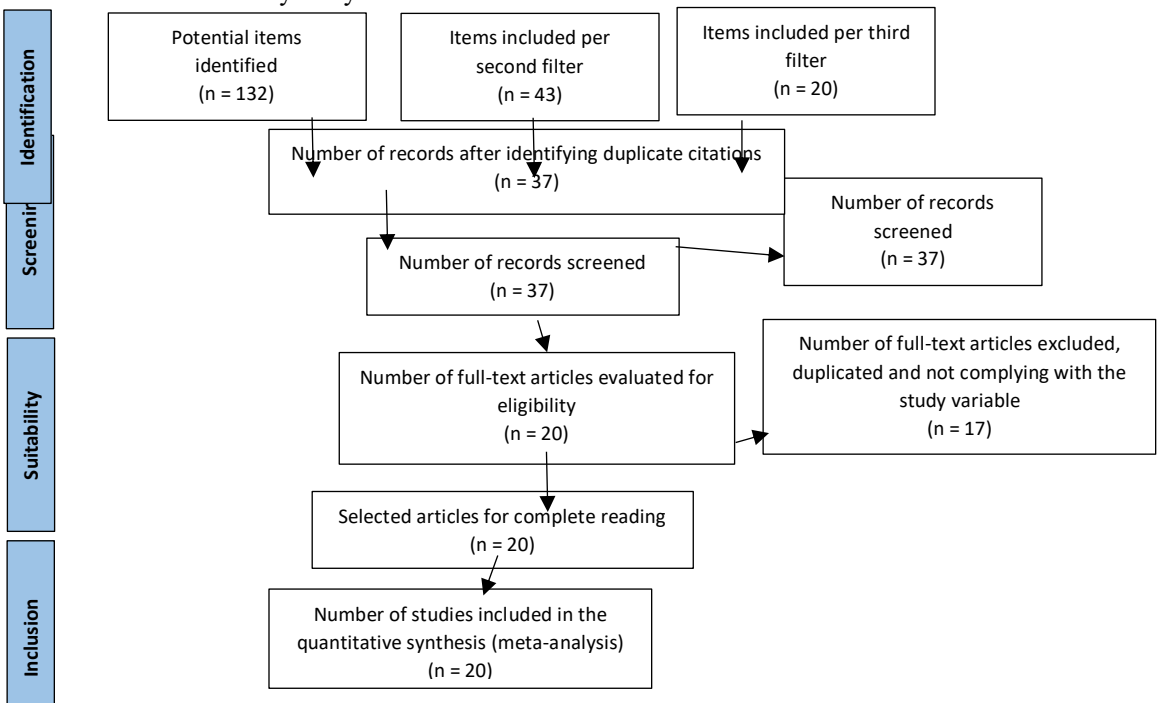

FIGURE 1. FLOWCHART OF SYSTEMATIC REVIEW PERFORMED UNDER PRISMA TECHNIQUE

(Moher, Liberati, Tetzlaff, Altman, & Group, 2009)

Source: Own el
aboration; based on the proposal of the Prisma Group (Moher, Liberati, Tetzlaff, Altman, & Group, 2009)

RESULTS

TABLE 3 SHOWS THE RESULTS AFTER APPLYING THE SEARCH FILTERS RELATED TO THE METHODOLOGY PROPOSED FOR THIS RESEARCH, AFTER RECOGNIZING THE RELEVANCE OF EACH OF THE REFERENCED WORKS.

No.	TITLE OF THE RESEARCH	AUTHOR/YEAR	COUNTRY	TYPE OF STUDY	INDIZATION
1	Survey on compressive sensing video stream for uplink streaming media	Liu, H., Huang, R., Yuan, H. (2021)	CHINA	QUALITATIVE	SCOPUS
2	Long-term rate control for concurrent multipath real-time video transmission in heterogeneous wireless networks	Chen, F., Zhang, J., Zheng, M., Wu, J., & Ling, N. (2021)	CHINA, USA.	QUANTITATIVE	SCOPUS
3	Multiple Description Coding for Best-Effort Delivery of Light Field Video using GNN-based Compression	Hu, X., Pan, Y., Wang, Y., Zhang, L., & Shirmohammadi, S. (2021).	CHINA, CANADA	QUANTITATIVE	SCOPUS
4	Efficient Multimedia Data Transmission Model for Future Generation Wireless Network	Kavitha, T., & Jayasankar, K. (2020).	INDIA	QUALITATIVE	SCOPUS
5	A Quality-driven Bit Rate Adaptation Method for Dynamic Adaptive Streaming over HTTP	Xie, G., Jin, X., Xie, L., & Chen, H. (2018).	CHINA	QUANTITATIVE	SCOPUS
6	Design and implementation of a video streaming	Liu, J., Li, Z., Lin, C., Yang, B., & Ge, M. (2018).	CHINA	QUANTITATIVE	SCOPUS

	adaptive algorithm based on markov prediction model				
7	Prediction and Modeling for No-Reference Video Quality Assessment Based on Machine Learning	López, J. P., Martín, D., Jiménez, D., & Menéndez, J. M. (2018).	SPAIN	QUALITATIVE	SCOPUS
8	Optimal Grouping-of-Pictures in IoT video streams	Panagidi, K., Anagnostopoulos, C., & Hadjiefthymiades, S. (2018).	GREECE. UNITED KINGDOM	QUANTITATIVE	SCOPUS
9	Adaptive video-aware forward error correction code allocation for reliable video transmission	Hussain, M., & Hameed, A. (2018).	PAKISTAN, USA	QUANTITATIVE	SCOPUS
10	CloudFog: Leveraging Fog to Extend Cloud Gaming for Thin-Client MMOG with High Quality of Service	Lin, Y., & Shen, H. (2016)	USA	QUANTITATIVE	SCOPUS
11	A real-time forward error correction of changing redundant packets' position for video transmission	Zhang, G., Zhang, X., Li, C., & Han, G. (2016).	CHINA	QUALITATIVE	SCOPUS
12	Blind quality algorithm to analyze streaming video contents in 5G networks	Ran, Z., Hadlich, R. R., Yang, R., Dayton, D. C., Mante, O. D., & Assanis, D. (2022).	United States	QUANTITATIVE	SCOPUS
13	Model Issues Regarding Modification of Fuel Injector Components to Improve the Injection Parameters of a Modern	López Velasco, J. P., Authier, A., Jiménez Bermejo, D., Menéndez García, J. M., & Sánchez Almodóvar, N. (2017)	SPAIN	QUALITATIVE	SCOPUS

	Compression Ignition Engine Powered by Biofuel				
14	Modeling and Analysis of Power Consumption in Live Video Streaming Systems	Sharrab, Y. O., & Sarhan, N. J. (2017).	USA	QUALITATIVE	WOS
15	Real-Time Adaptation to Time-Varying Constraints for Medical Video Communications	Antoniou, Z. C., Panayides, A. S., Pantzaris, M., Constantinides, A. G., Pattichis, C. S., & Pattichis, M. S. (2017).	CHIPRE, REINO UNIDO, USA	QUALITATIVE	WOS
16	Towards the availability of video communication in artificial intelligence-based computer vision systems utilizing a multi-objective function	Sharrab, Y. O., Alsmadi, I., & Sarhan, N. J. (2022).	JORDANIA, USA	QUANTITATIVE / QUALITATIVE	WOS
17	Sliding-window forward error correction using Reed-Solomon code and unequal error protection for real-time streaming video	Weng, Y. T., Shih, C. H., & Chou, Y. K. (2018).	TAIWAN	QUANTITATIVE	WOS
18	Quantization Parameter Cascading for Surveillance Video Coding Considering All Inter Reference Frames	Gong, Y., Yang, K., Liu, Y., Lim, K. P., Ling, N., & Wu, H. R. (2021).	CHINA, USA, SINGAPUR, AUSTRALIA	QUALITATIVE	WOS
19	VCMaker: Content-aware configuration adaptation for video streaming and analysis in	Chen, N., Zhang, S., Quan, S., Ma, Z., Qian, Z., & Lu, S. (2021)	CHINA	QUANTITATIVE	WOS

	live augmented reality				
20	Adaptive Source-FEC Coding for Energy-Efficient Surveillance Video Over Wireless Networks	Wu, J., Cheng, B., & Wang, M. (2017).	CHINA	QUANTITATIVE	WOS

TABLE 3. LIST OF ANALYZED ARTICLES

Source: Own elaboration

The 20 documents listed in the table above correspond, as mentioned above, to the search performed in the Scopus and Wos databases, without discriminating by country of origin of the publication or area of knowledge. It is important to note that before the preparation of Table 1, arguments of competence and relevance were taken into account for the subsequent individual analysis of each text.

4.1 Co-occurrence of words

Figure 2 shows the relationship between the keywords used for the search of the study material for the elaboration of the systematic analysis proposed for this research.

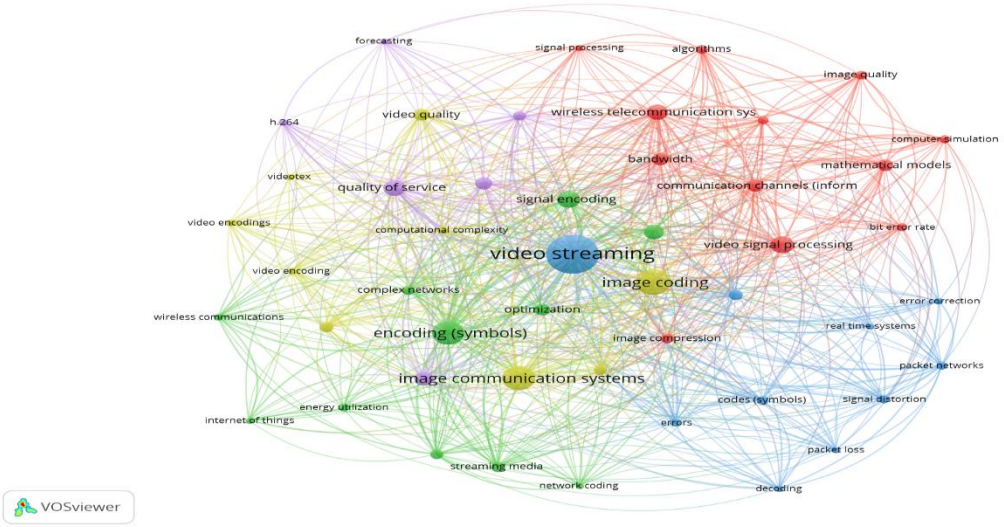

FIGURE 2. KEYWORD CO-OCCURRENCE.

Source: Own elaboration

Video Streaming was the keyword most frequently used in the research identified in the databases referenced above. This has been associated with the development of different methodologies, most frequently with studies in Image Coding, Signal Coding, Optimization, Image Coding Systems, and Communication Channels, which allows confirming the relevance of the identified publications, with the development of this article in compliance with the stated objective. As can be seen in the figure, the researchers, represented by the most frequently used keywords, are identified by colors and subsets. Those that are in the segment of variables with the red color, focus on the study of the signal conditions and the transmission through the web through different channels, within these the most common were Video Signal Processing, Broadband, Communication Channels,

Mathematical Models, Wireless Communication System, among others. On the other hand, the research identified with the yellow color revolves around transmission, keywords such as Media Streaming, Wireless Communication, Internet of Things, Complex Networks, and Network Coding, among others.

DISCUSSION

The objective of this article was to analyze from a systematic perspective, the position of the different authors associated with the research works referenced in it, seeking to organize a compendium of theoretical bases that support the generation of new knowledge related to the transmission models used for video streaming, as well as the video coding systems mostly used today. Therefore, the research works referenced in Table 3 have been analyzed, where the article entitled "Long-term rate control for simultaneous transmission of multipath real-time video in heterogeneous wireless networks" is included (Chen, Zhang, Zheng, Wu, & Ling, 2021). The purpose of the study was to propose a novel rate control for simultaneous multipath video transmission. The researchers developed a mathematical model to formulate the nonconvex long-run quality maximization problem, as well as a dynamic programming solution for online coding bit rate control based on buffer state.
Thanks to the above, the researchers determined that, through the experiments conducted, it is demonstrated that the proposed long-term rate control scheme achieves appreciable improvements over the short-term rate control schemes in terms of video quality and delay performance. Similarly, a very useful proposal for the fulfillment of the aforementioned purposes is recorded in the article entitled "Design and implementation of an adaptive video transmission algorithm based on the Markov prediction model" (Liu et al., 2018). The objective was to design and implement the model-based adaptive video streaming algorithm by predicting the size of time series B-frames. The designed model takes the bandwidth value predicted by the GCC (Google Congestion Control) blocking control algorithm, thus discarding the B-frames selectively to increase the video transmission utilization under the same band, decreasing the bandwidth demand, which results in the improvement of the quality and self-adaptability of the transmission bandwidth, thus improving the user QoE.
Both of the above cases show mechanisms to improve the experience in the transmission of videos in real-time, and it is important to highlight its applicability in key areas for the development of life itself, so it has drawn attention to the results obtained in the research entitled "Adaptation in real time to time-varying constraints for medical video communications" (Antoniou et al., 2017), whose objective was to propose an adaptive video coding framework based on multi-objective optimization that jointly maximizes the encoded video quality and coding rate (in frames per second) while minimizing the bit rate demands. The research determined that the bit rate demand is significantly reduced through the construction of a dense coding space and the use of prediction models in an adaptive control framework that can adjust video coding based on real-time constraints. The prediction models can estimate structural similarity quality with an average precision error of less than 1 %, bit rate demands with a deviation error of 10 % or less and an encoding frame rate within a margin of 6 % (Antoniou et al., 2017). The model designed can be replicated in any area of knowledge, but it is expected to demonstrate its effectiveness in the transmission of videos in the area of medicine to increase accuracy in meeting the demand for health services and improving the quality of life of hundreds of thousands of patients.

CONCLUSIONS

This review article concludes by highlighting the importance of knowing the updated state of the literature published in databases such as Scopus or WoS, concerning the study of transmission models used in video streaming and video coding systems most frequently used in its transmission. The results show a considerable amount of published research on the management of new technologies for communication, as well as innovative models for improving the quality of video transmission in real-time, which constitutes an important support material in the generation of new knowledge aimed at taking advantage of technological advances for the different aspects of everyday life, from recreation, through the provision of audiovisual content via streaming platforms such as Netflix, to the application of strategies based on algorithms associated with the development of new and better technological tools for the transmission of information in the medical area. These have already been tested and evaluated in their performance, determining, by the authors cited in this document, the effectiveness in the processes of consultation and timely care for patients with non-vital emergencies that do not require immediate intervention. This has been possible thanks to the constant generation of new knowledge associated with the progress in the models implemented in video streaming applicable, as mentioned above, to multiple aspects such as education, security, health, and work, among others. It is possible to conclude that

through the study of the contributions that the authors have made to the mentioned area, it is possible to build important theoretical bases to encourage the generation of new knowledge on the subject of the use in the continuous improvements of ICT devices, as well as programs designed for the transmission of information with increasingly higher quality and greater utilities.

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