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Study of SWT-ANN Based Indoor Optical Wireless Communication System: A Review

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Abstract: ***This paper reviews on optical wireless system using stationary wavelet and neural network. High-speed wireless optical communication links have become more popular for personal mobile applications. This is a consequence of the increasing demand from the personal information service boom. Compared to the radio frequency domain, optical wireless communication offers much higher speeds and bit rates per unit power consumption. This work presents the use of wavelet transform and artificial neural network as elements of optical wireless communication receiver. The main objective is to minimize the error on receiver side. Indoor wireless links usually have to operate in presence of noise generated by light sources. In this, OOK and PPM modulation formats will be used. The performance of this system is analysed based on BER value. All simulations will be done in MATLAB.***
Keywords: Artificial neural network (ANN), optical wireless communication (OWC), wavelet transform etc.

I. INTRODUCTION

In modern era, there is a transition of computing total power from computer to laptops and smart phones. There are various devices like digital cameras, laptops; computers provide users for processing and capturing a large amount of data. Though, there is a challenge for transfer of data between devices because of small size and low cost. There is a requirement of some high performance links that allowed exchange of data from portable devices. It provides a connection for establishment computing infrastructure such as storage devices for data and various different peripherals. They have the ability to form ad hoc network between various portable devices.

Optical wireless communication may be defined as the broadcasting of light beam in atmosphere which is modulated. It is used to provide broadband communication. The origin of this communication is in ancient times when they used the fire beacons for transfer message data over distances. It was the pioneering research work done by F.R. Gfeller and U. Bapst in 1979 that inspired the technical community to explore further the potential of the indoor optical wireless communication. In comparison to RF, optical wireless communication enjoyed benefits such as: lower implementation cost, higher security, unregulated spectrum and operational safety.

In past times, people uses the optical light source for data transmission. Homar, in Iliad, suggested that optical signals can use for data transmission around 1200 BC in Grecian siege of Troy. They used the Fire Beacons between mountains for transmission of data. Though in communication system, it is able for transmission of single bit of data, this was the fast way for data transmission. In 1790, Mr. Chappe discovered the telegraph based on optical signal that was used to send data over distance. It can be done by changing orientation of signal. It developed a code book of orientations of different signals that was used to encode letters of numbers and some common used words and different signals. It could send the data message over long distance in few minutes.

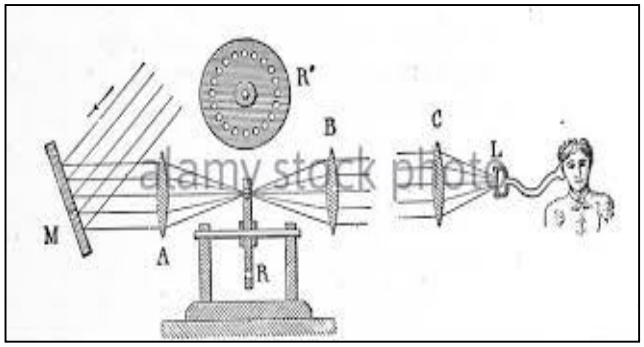

Figure 1: Drawing of the photo-phone by Alexander Graham Bell and Charles Sumner Tainter, April 1880

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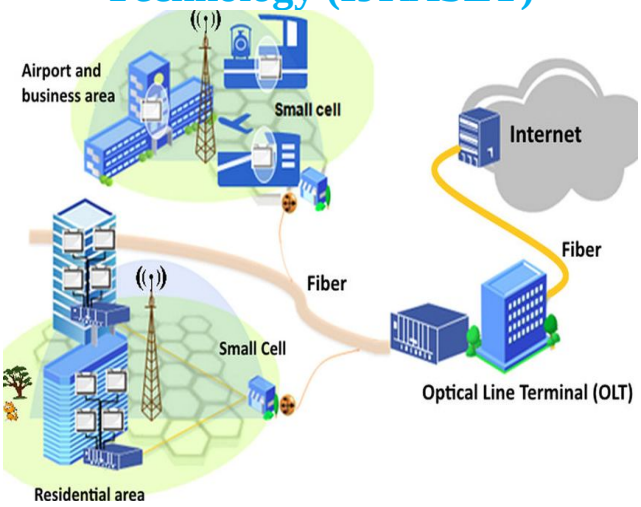


Figure 2: An Optical Wireless System [1]

The ISI caused by multipath propagation and artificial light interference from fluorescent lamp driven by electronic blast are two major interferences, and these need to be taken into account when validating modulation schemes. The main interferences for Infrared communication channel including background noise and multipath inter symbol interferences (ISI). The multipath ISI was mainly account when designing communication systems. In order to improve channel throughput, the first step was to set up the appropriate channel model.

The main interferences for Infrared communication channel including background noise and multipath inter symbol interferences (ISI). The multipath ISI was mainly limited by transmitter and receiver geometry. The receiver can transmit data or communicate with the transmitter with the help of a multipath link. In this case, the multi-path links can cover areas that cannot be reached through a LOS links. The background noise caused by the ambient light from sun light and artificial light can be intense. The background light noise can affect optical wireless system that employing the Infrared spectrum.

Due to the physical properties of the link, mostly systems with optical wireless scheme employed intensity modulation and direct detection (IM/DD). X(t) signifies the immediate optical power from the emitter, Y(t) indicates the instantaneous current generated by the photo-detector. Since the surface of the photo-detector was millions of square wavelengths at the received optical signal wavelength, the optical link will not suffer from multipath fading effects that usually experienced by the RF system.

The paper is organized as follows. Section II presents the related work of system. In section III, It describes concept of optical wireless system with wavelets. The problem is given in Section IV. Finally, conclusion is explained in Section V.

II. RELATED WORK

Muhsin Caner Gökçe et.al.[2015] presented an FSO systems that was employed multiple –input single –output techniques. Its effects of turbulences and even their link can be improved. They considered the finite sized systems. They contained Huygens Fresnel principle that defined the average power atmosphere. This system helped to find the performances of proposed network. Th degrees of coherence, the structure of constant were also affected [3].

Mohamed Kashef et.al.[2015] believed a light communication {VLC) system in which multiple access points {APs) data to a number of mobile terminals {MTs). The optimal transmission power control requires information about the exact locations of the MTs. They considered the cases employed limited available information about the MTs. In this system the APs employed optical OFDM with power control. A centralized controller based on the available information about the MTs. The various system of parameters on the achieved utility function including the average number of MTs, the APs and MTs locations. APs required the illumination powers. The transmission powers based on various utility functions including maximizing the summation of the achieved rates of the MTs. The source size and the ring radius were affected by the system [4].

Refik Caglar Kizilirmaket. al. [2015] presented a Non-orthogonal multiple access (NOMA) multiple access technique for future cellular systems. In this work, based on a realistic indoor channel conditions, we apply NOMA to indoor VLC channels and demonstrate its superior performance over orthogonal frequency division multiple access (OFDMA).For a realistic indoor channel model with illumination design constraints, the superior per-formance of NOMA over conventional

OFDMA scheme has been demonstrated. Although, the receiver complexity can be seen as a drawback for NOMA, the return is considerable [5].

Mohammad Jamali et.al [2015] presented a MIMO-UWOC in which they found the BER performances. To efficiently estimate the BER expressions, then used Gauss-Hermite Quadrature formula. That was confirmed to the correctness of log-normal random variables. They also confirmed the logical terms by the BER through photon- counting approach. After that, result showed MIMO channel can extend the communication ranges, especially for turbulence [6].

Haitao Mao et.al [2015] presented a system of optical wireless nature with a receiver having non- imagination that consists of 2*2 array of LEDs and having 2*2 photo-detector with 12 mbps channel. An experimental demonstrated an MIMO optical wireless system that contains 2*2 array of LEDs source. It provided a space of 2*2 array of photo-detector with space of 12 Mb per sec per channel. Smaller BER was achieved in this BER operation at separating transmitted information, zero forcing MMSE thesaurus .optical design had been set up, and its reported [7].

F.S. Marzano et.al.[2015] presented a system that was delicate for some atmospheric situations. Various impairments were introduced like air turbulence that reduced the availability of channel. It was used for estimation of model for refractive index structure and also for statistics of scintillation fade model in near infrared region that was available near Italy and Germany. That was performed using FSO. That was campaign near Munich for both terrestrial and slant links. It explicated of measured meteorological RAOB profile data, available twice a day all over the world. Preliminary results about the validation scintillation-index simulations had been shown by using published data of DLR experiments. The comparisons is performed on a more detailed and quantitative basis [8].

Steven De Lausnay et.al.[2014] presented the use of codes in Optical CDMA that was used for indoor localization using Intensity and direct detection {IM/DD). This can be used as signal which is baseband in nature that provided the lashing electronics less multifarious. It does not provide a backbone network between LEDs. It was used for providing installation in CDMA System where cross- correlation was arbitrary. An arrogated High Pass Filter should be occupied by the bipolar codes. These codes were analyzed with suitable receiver. A High Pass filter was used by codes and similar code length were used. It provided suitable for the enclosed localization scheme. It provided high power that has been constructed easily [9].

PoompatSaengudomlertet.al.[2014] presented the transmission of message scheme that was based on OFDM which was uni-polar in nature. It provided the scheme using frequency domain in which pre-equalization was provided for reduction of signal. In this work, it provided as an optional scheme for modulation that shows the power efficient. In this, the bit rate used was 10 Mbps for this scheme using optical wireless modulation transmission. The performance of coherent OFDM and Flip OFDM were investigated in terms of BER. The transmission performance of system using transmit optical power were evaluated in terms of BER that provided the reduction in transmit optical power which was dispersive in nature. The results were provided with minimum BER [10].

Jariya Panta et.al.[2014] presented the transmission of message scheme that was based on intensity modulation which was unipolar in nature. The wireless channels used for partial pre-equalization that can reduce transmit optical power is used under point to point communication. It provided the transmission for multiple users under broadcasting with different qualities of channel. So, in this work, it described the suitable method for channel estimation at transmitter. The pre-equalization used can provide reduction in error of signal that was used under practical circumstances. It can use the partial pre-equalization for broadcasting system [11].

Suriza Ahmad Zabid et.al.[2014] presented an alternative scheme for communication under last segment where it was not used the concept of fiber optics. It was because of high cost and deployment problem. The use of same optical fibre that provided high speed in scheme under optical wireless system. The systems under Optical wireless scheme were higher speed and low cost. The transmission of data availability was dependent on some factors. The fog and snow were obstructions in propagation of link in system. The parameter rain attenuation under optical wireless link was used for measured data. The proposed and predicted schemes were evaluated [12].

III. INDOOR OPTICAL WIRELESS COMMUNICATION NETWORK SYSTEMS

A. Modulation for Optical Wireless Communication

The optical channel is quite different from the conventional RF channel. This consequently resulted in a different approach when it came to the modulation design. Modulation schemes which fit well in electromagnetic channels were not necessarily perform well in the optical domain. Modulation techniques remained an active topics amongst both academic researchers and industrial communication system engineers. Depending on the nature of the information source, modulation can be summarized as analogue or digital formats.

1) On-Off-Keying (OOK): The OOK modulation scheme was one of the simplest modulation techniques. It was commonly used because of its easy implementation. By default, the OOK modulation refers to the Non Return to Zero (NRZ) OOK, and this is different from the Return to Zero (RZ) OOK modulation by a fraction of γ, where $\gamma \in (0,1]$.
2) Pulse Amplitude Modulation (PAM): The PAM modulation technique belonged to pulse amplitude level modulation scheme. Consider L-level PAM (L-PAM), That is, one of L possible amplitude levels transmitted from the transmitter to represent a specific value.
3) Pulse Position Modulation (PPM): In PPM, transmitted optical signals were represented by the location of the pulse within a clock cycle. As a result, synchronization between transmitter and receiver was required or assumed when comparing PPM schemes with other schemes. In addition, the PPM modulation scheme was also regarded as particular version of an L-position PPM (L-PPM) system.

B. Bit error rate and ISI

It's a narrowband technology that uses multiple transmits and receives antennas. If H is the channel matrix then we have Y = Hx + n (1) The number of independent channels that a signal travels from the sender to the receiver is called as the diversity gain. The proper operation of MIMO systems requires careful design, with the encoded signals received from each transmitting antenna and the multiple communication channels achieving specified orthogonality conditions. The better combination of number of transmitting and receiving antenna for MIMO systems in BPSK modulation technique that satisfy the good SNR is to be investigated primarily. The following multi-antenna MIMO communication system consist of n transmit antenna and m receive antenna, and in some case with a slowly time-varying channel. Due to the wireless nature of the system, each receive antenna receive transmission from all transmitter.

By slowly time-varying, we assume the channel remain constant over a block of data consists of N symbols.

$$P_e = \frac{1}{2}\text{erfc}\left[\sqrt{\frac{E}{No}}\right]^*$$

Where E is the energy signal, the value of the bit error increase as the energy increases, the value of complementary error function erfc decreases and the value of bit error reduce.

C. Stationary Wavelet Transform (SWT)

The Stationary wavelet transform (SWT) is an algorithm designed to overcome the lack of translation-invariance (DWT). Translation-invariance is achieved by removing the down-samplers and upsamplers in the DWT and upsampling the filter coefficients by a factor of 2^j in the jth level of the algorithm. The SWT is an inherently redundant scheme as the output of each level of SWT contains the same number of samples as the input – so for a decomposition of N levels there is a redundancy of N in the wavelet coefficients. This algorithm is more famously known as "algorithme à trous" in French (word trous means holes in English) which refers to inserting zeros in the filters.

IV. PROBLEM FORMULATION

The ISI caused by multipath propagation and artificial light interference from fluorescent lamp driven by electronic blast are two major interferences, and these need to be taken into account when validating modulation schemes. The main challenge faced by this work is to seek the most optimized modulation scheme that can provide maximum system throughput while capable of withstanding most if not all of the intense channel interferences at a target BER requirement. Bandwidth efficient schemes such as the OOK and PPM are prone to artificial lighting interferences. This led to a natural conclusion of a modulation scheme that can combine benefits from both above candidates and able to avoid the drawbacks of each individual scheme. So, in this work, ANN-based receiver for modulation technique including OOK is proposed. It uses SWT system at receiver and then compares its performance with wavelets

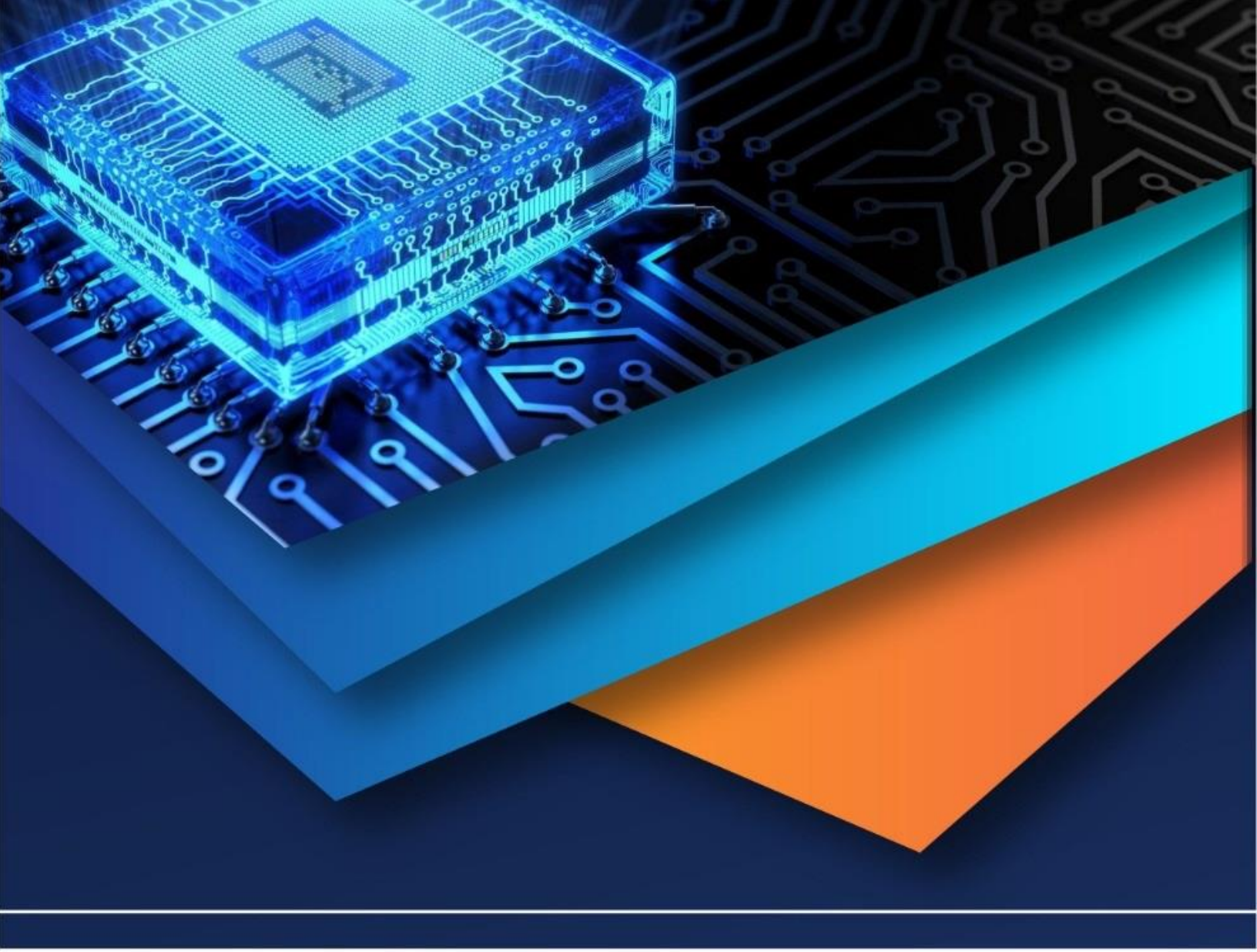
V. CONCLUSION

This work presents the review on an optical wireless system that will include the wavelet and ANN at receiver side. Optical wireless communication is become an attractive alternate technology to optical fiber and RF communications for certain applications such as the last mile access in the indoor systems. This work presents the use of indoor optical wireless systems, which can meet the need of different applications. With the help of wavelets and ANN based receivers the different type of problems comes in that system are get reduced. The ANN network is used for the minimization of error and the wavelets are used for better receiver response. With

the help of this, it may prove the better stability of system.

REFERENCES

[1] W. A. Gambling, "Glass Fibre for Optical Communications," IEEE International Conference on Physics and Chemistry of Glasses, vol. 21, No. 1, Feb 1980.
[2] T. S. Rappaport, "Wireless personal communications: trends and challenges," IEEE Antennas and Propagation Magazine, vol. 33, pp. 19- 29, 1991.
[3] Muhsin Caner Gökçe, Yahya Baykal, "Effect of Partial Coherence on MISO FSO Systems", IEEE International Workshop on Optical Wireless Communications, pp 88-92, Sep 7-8, 2015.
[4] Mohamed Kashef, Mohamed Abdallah, and Khalid Qaraqe, "Cooperative OFDM-based Multi-User Visible Light Communication Systems with Limited Information", IEEE International Workshop on Optical Wireless Communications, pp 102-106, Sep 7-8, 2015.
[5] Refik Caglar Kizilirmak, Corbett Ray Rowell, "Non-Orthogonal Multiple Access (NOMA) for Indoor Visible Light Communications", IEEE International Workshop on Optical Wireless Communications, pp 98-101, Sep 7-8, 2015.
[6] Mohammad Jamali, and Jawad Salehi, "On the BER of Multiple-Input Multiple-Output Underwater Wireless Optical Communication Systems", IEEE International Workshop on Optical Wireless Communications, pp 26-30, Oct 1, 2015.
[7] Haitao Mao, Yanqing Guo, "Indoor Optical Wireless MIMO System with a Non Imaging Receiver", IEEE International Conference on Optical Communications and Networks, pp 1-4, July 6, 2015.
[8] F.S. Marzano, D. Carrozzo, "Clear-air Turbulence Effects Modeling on Terrestrial and Satellite Free-Space Optical Channels", IEEE International Workshop on Optical Wireless Communications, pp 36-40, Sep 7-8, 2015.
[9] Steven De Lausnay, Lieven De Strycker, "Optical CDMA Codes for an Indoor Localization System using VLC", IEEE 3rd International Workshop in Optical Wireless Communications, pp 50-54, Sep 17, 2015.
[10] Poompat Saengudomlert, "On the Benefits of Pre-Equalization for ACO-OFDM and Flip-OFDM Indoor Wireless Optical Transmissions Over Dispersive Channels", IEEE Journal of Lightwave Technology, Vol. 32, No. 1, pp 70-80, January 1, 2014.
[11] Jariya Panta, Poompat Saengudomlert, "Performance Analysis of Partial Pre-Equalization for ACO-OFDM Indoor Optical Wireless Transmissions", IEEE 9th International Symposium on Communication Systems, Networks & Digital Sign, pp 1029-1033, July 23-25, 2014.
[12] Suriza Ahmad Zabidi, Islam MdRafiqul, "Rain Attenuation Prediction of Optical Wireless System in Tropical Region", IEEE International Conference on Smart Instrumentation, Measurement and Applications, pp 1-5, Nov 25-27, 2013.
[13] Hao Du, Roger Green, "Optical Wireless 2x2 Indoor MIMO System Based on OOK Modulation", IEEE International Conference on Transparent Optical Networks, pp 1-3, June 23-27, 2013.
[14] Wasinee Noonpakdee, "Adaptive Wireless Optical Transmission Scheme for Health Monitoring System", IEEE Third International Conference on Consumer Electronics, pp 161-164, Sep 9-11, 2013.
[15] Yeon-Mo Yang, Soeun Kim, "Performance of an indoor optical wireless communication system employing convolutional encoding", IEEE Photonic Global Conference, pp 1-3, Dec 13-16, 2013.



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