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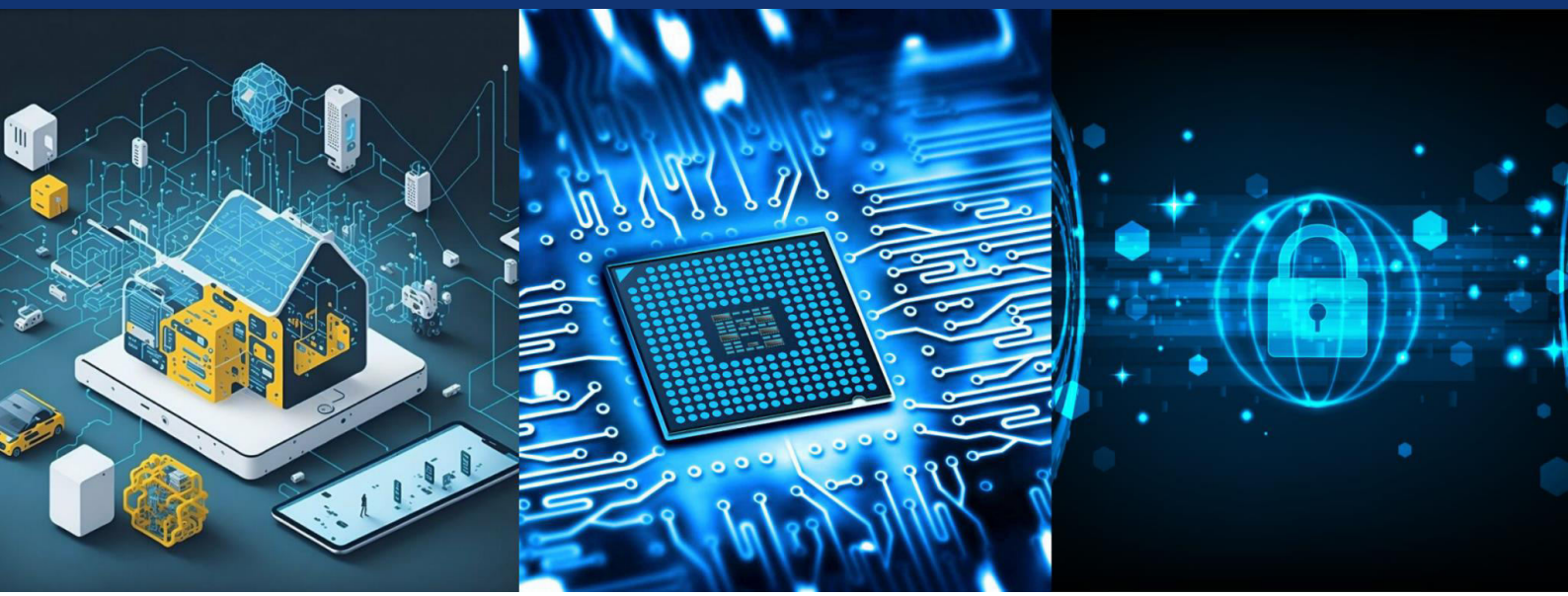

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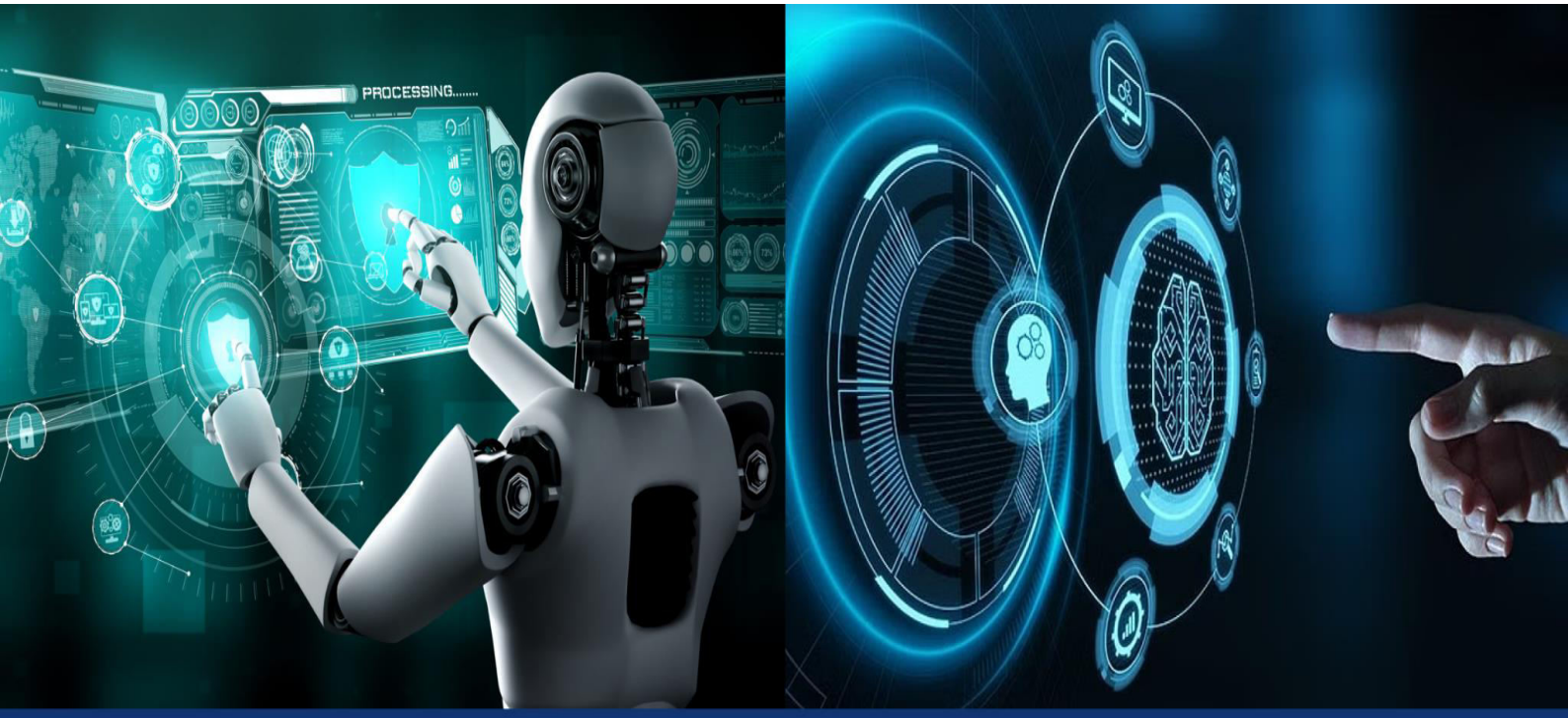

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Design and Implementation of Smart Surveillence System for Online Exam and Virtual Interview

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ABSTRACT: This project aims to develop an AI-based proctoring system that enhances the integrity of online interviews and virtual examinations through real-time participant movement tracking and lip-sync analysis. By leveraging advanced computer vision techniques and machine learning models, the system continuously monitors facial and physical behaviours to detect and prevent various forms of malpractice. A key feature of the system is its ability to analyse lip movements in synchronization with audio input, flagging any discrepancies as potential indicators of fraudulent activity. Additionally, gaze estimation is implemented using frameworks such as MediaPipe and Dlib to detect off-screen distractions or the presence of multiple individuals. The system captures and processes video and audio data in real time, automatically generating alerts for examiners or HR personnel when suspicious behaviour is identified. This comprehensive surveillance solution strengthens the security, fairness, and credibility of remote assessments, making it an effective tool for educational institutions and corporate organizations.

KEYWORDS: Real-time proctoring, lip-sync analysis, movement tracking, computer vision, OpenCV, machine learning, facial recognition, remote examination security, online interview integrity, malpractice detection, AI-based surveillance, audio-visual synchronization, virtual assessment monitoring.
Domain: Artificial Intelligence

I. INTRODUCTION

This project presents a Smart Surveillance System designed to enhance the security and integrity of online examinations and virtual interviews. With the rapid shift toward remote education and virtual recruitment, traditional platforms often lack the capability to verify candidate identity or monitor behaviour effectively, making them vulnerable to impersonation and malpractice. To address these challenges, the proposed system integrates real-time facial recognition, participant movement tracking, and lip-sync analysis using advanced computer vision and machine learning techniques. By synchronizing audio and visual data, the system can detect inconsistencies between spoken words and lip movements, thereby identifying potential fraudulent behaviour. This AI-driven solution offers a comprehensive and automated approach to safeguard remote assessments, ensuring credibility and trust in virtual evaluation environments.

II. LITERATURE SURVEY

"Effectiveness of Pre-Trained CNN Networks for Detecting Abnormal Activities in Online Exam" This study focuses on the use of deep learning models to detect cheating behaviours during online examinations. It proposes the use of motion-based keyframe extraction followed by classification using pre-trained models such as YOLOv5, Inception-V3, Inception-ResNet-V2, and DenseNet121. The authors developed a real-world dataset containing four common cheating behaviours.

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"Smart Online Exam Proctoring Assist for Cheating Detection" This paper presents a framework for intelligent proctoring of online exams using AI-based tools. The proposed system leverages visual features such as eye gaze and head movements to recognize suspicious behaviour. The method transforms videos into multivariate time-series data and uses LSTM-based deep learning models for classification. It addresses limitations in manual proctoring and enhances cheating detection using an automated approach, showcasing the utility of AI in online education environments.

"A Survey of Chatbot Implementation in the Customer Service Industry via Deep Neural Networks" In this check, Hussain investigates how deep neural networks are employed to apply chatbots within the client service sector. The paper reviews the armature and training methodologies of neural- grounded chatbots, pressing their impact on automating client relations, reducing response time, and perfecting stoner satisfaction. It also discusses current limitations and unborn advancements for AI- driven client support systems.

"A Cheating Detection System in Online Examinations Based on the Analysis of Eye-Gaze and Head-Pose" Singh and Das propose an AI-driven solution for online exam monitoring using eye-gaze tracking and head-pose estimation. The model identifies behavioural anomalies such as looking away from the screen or turning the head frequently, which are indicative of potential cheating. Their system combines video analytics and poses estimation to flag suspicious behaviour in real time. The paper emphasizes the importance of non-intrusive, real-time monitoring in online exams and presents a viable method for academic integrity assurance.

III. METHODOLOGY

A. EXISTING SYSTEM

In the existing approaches, several pre-trained Convolutional Neural Network (CNN) models have been employed to detect and classify suspicious behaviours captured in video frames during online assessments. The existing system for detecting abnormal activities in online examinations leverages several advanced pre-trained Convolutional Neural Network (CNN) architectures known for their efficiency and accuracy in image and video analysis. One of the primary models used is **YOLOv5**, a one-stage object detection framework that is highly effective in identifying multiple actions within a single frame in real-time, offering both speed and precision. **DenseNet121** is also utilized, known for its densely connected layers where each layer receives input from all preceding layers, promoting feature reuse and reducing the number of parameters needed, thus enhancing model efficiency.

B. DISADVANTAGE OF EXISTING SYSTEM

1. The system does **not include user verification mechanisms**, such as Email verification.
2. It is designed to work on **pre-recorded videos only** and does **not support real-time monitoring or alerts** during the exam.
3. It relies only on video frames, without using gaze tracking or facial expression analysis.
4. No use of advanced AI methods like multimodal learning or decision-level fusion.
5. No data storage support and may misclassify under poor lighting or varied environments.

C. PROPOSED SYSTEM

This project presents a real-time, AI-driven Proctoring System designed to enhance the security, integrity, and transparency of online examinations and virtual interviews. The system leverages advanced computer vision technologies, primarily OpenCV and Dlib, to detect and verify the candidate's face at the beginning and throughout the session, ensuring that only the registered user is present. Once authenticated, the system continuously records both video and audio streams, enabling real-time surveillance and post-session validation. A key component of the system is its ability to detect and analyses lip movements in real time, effectively identifying mismatches between spoken audio and lip motion. This functionality is crucial for preventing impersonation, voice dubbing, and playback-based cheating attempts. Additionally, the system monitors gaze direction to detect prolonged off-screen glances, which may indicate distraction or attempts to access unauthorized material. To further strengthen session integrity, the system incorporates multi-person detection to flag instances where more than one individual is present within the camera frame. At the conclusion of the session, a comprehensive report is automatically generated, summarizing all detected anomalies and behavioural patterns for examiner or HR personnel review

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D. ADVANTAGES OF PROPOSED SYSTEM

1. **Real-Time Monitoring and Detection:** Provides immediate responses anytime, reducing the need to wait for human consultations.
2. **Multi-Modal Cheating Prevention:** Integrates facial recognition, gaze tracking, and lip-sync analysis for multi-modal cheating prevention.
3. **Automated Reporting and Evidence Generation:** Automatically generates structured session reports for post-assessment review and validation.
4. **Cross-Platform Integration:** Supports seamless integration with existing online exam and interview platforms.
5. **Scalability and Efficiency:** Scales efficiently to monitor multiple users simultaneously without performance loss.
6. **Cost-Effective and Resource-Efficient:** Reduces the need for human proctors, lowering operational costs while maintaining reliability.

E. DESIGN OF THE SYSTEM

The proposed system is designed to ensure the integrity of online assessments and interviews through a multi-layered authentication and monitoring approach. Initially, the system verifies user identity via a robust authentication process, which includes email verification, face authentication using computer vision techniques, and password authentication as a secondary check. Once authenticated, candidates proceed to an online exam or aptitude test as a preliminary screening, followed by a technical interview round for those who pass the aptitude test. Real-time monitoring tools are employed throughout the process to detect suspicious activities or attempts to compromise the assessment. These include window monitoring to detect any unauthorized switching of browser tabs or opening of applications, as well as continuous screen recording for post-session analysis. After the technical interview, candidates undergo an HR round to assess their behavioural suitability for the role. It reduces the risk of cheating and ensures a fair, secure online assessments. These include gaze tracking to detect distractions, and lip-sync analysis to identify mismatches between speech and lip movements, indicating possible impersonation. Gaze cheating is flagged when candidates look off-screen for prolonged periods. All activities are logged for post-session review, ensuring accountability. This real-time, multi-layered monitoring significantly reduces cheating and promotes a fair and secure online assessment environment.

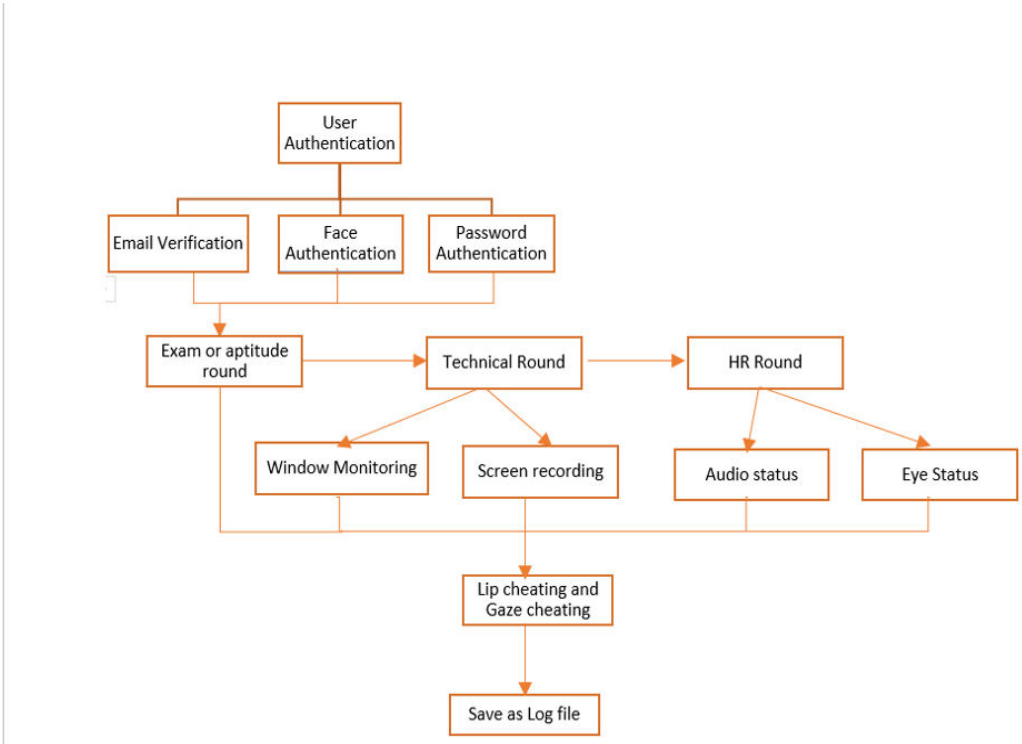

Fig.1

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F. COMPARISON WITH EXISTING WORK

Unlike conventional proctoring systems that primarily depend on offline analysis using convolutional neural networks (CNNs) such as VGG16, VGG19, ResNet50, and InceptionV3, the proposed system adopts a real-time, AI-powered surveillance approach to ensure the integrity of virtual assessments. Existing systems are typically limited to post-exam video analysis, where candidate recordings are split into frames, classified independently, and reviewed through majority voting. This method, while functional, is time-consuming, lacks automation, and fails to provide timely intervention during the examination or interview. In contrast, the proposed system introduces a proactive and intelligent framework that continuously monitors candidates in real time using advanced computer vision libraries like OpenCV and Dlib. By integrating modules for facial recognition, gaze tracking, lip-sync analysis, and multi-person detection, the system delivers dynamic, automated supervision capable of identifying impersonation, distraction, or unauthorized assistance as it occurs. Unlike traditional methods, which store data without actionable insight, this system also generates structured reports and alert logs for immediate and post-session review

IV. IMPLEMENTATION

MODULE DESCRIPTION

1. User Authentication Module:

This module ensures the candidate's identity through a dual verification mechanism combining facial recognition and email-based OTP authentication. At the beginning of a session, the system captures the candidate's facial image via a webcam and analyses it using facial feature extraction algorithms. It then compares the captured image with stored reference data to verify authenticity. Simultaneously, a one-time password (OTP) is generated and sent to the candidate's registered email address. Authentication is granted only upon successful face match and correct OTP entry. In the case of mismatches or failed verification, the system triggers alerts, thereby reinforcing session security from the outset.

2. Real-Time Monitoring Module:

This module continuously supervises candidate activity throughout the assessment session to detect any anomalies or signs of malpractice. Leveraging OpenCV for visual tracking and DeepSpeech for audio verification, the system ensures the candidate remains actively present and their responses are legitimate. Real-time face detection keeps the candidate within the frame, while gaze tracking evaluates eye movements to identify distractions such as frequently looking away from the screen. Additionally, the system monitors for prohibited actions like screen sharing or tab switching, generating alerts when suspicious activity is detected.

3. Lip-Syncing and Speech Recognition Module:

This module ensures that the candidate's verbal responses are authentic and not manipulated. By analysing the synchronization between lip movements and spoken audio using DeepSpeech and computer vision techniques, the system validates speech authenticity. Discrepancies between detected lip movement and speech signals trigger automatic flagging. The system also logs the session activity and stores observations in a structured CSV report, providing detailed post-session review for examiners or HR personnel.

4. Facial Recognition and Multi-Person Detection Module:

To prevent impersonation and unauthorized assistance, this module conducts continuous facial recognition throughout the session. Using AI-based models, it matches the candidate's face in real-time with pre-registered data to ensure consistency. Simultaneously, it employs multi-person detection to identify any additional individuals appearing within the camera frame. If unrecognized faces are detected, the system raises immediate alerts. This dual-layered approach significantly enhances the system's reliability in upholding session integrity.

V. RESULT AND DISCUSSION

The implementation of the Smart Surveillance System for online examinations and virtual interviews demonstrated significant effectiveness in detecting and mitigating a wide range of malpractice behaviours through real-time visual and audio analysis. The system performed robustly across multiple testing scenarios, accurately identifying candidate behaviors such as off-screen distractions, unauthorized assistance, and lip-audio mismatches.

During evaluation, the **lip-sync detection module** showed high accuracy in identifying inconsistencies between spoken words and lip movements, effectively distinguishing genuine speech from pre-recorded or external audio. Similarly, the

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gaze tracking component, powered by MediaPipe and Dlib, successfully detected off-screen glances and multiple person intrusions—key indicators of potential malpractice.

Fig: 1

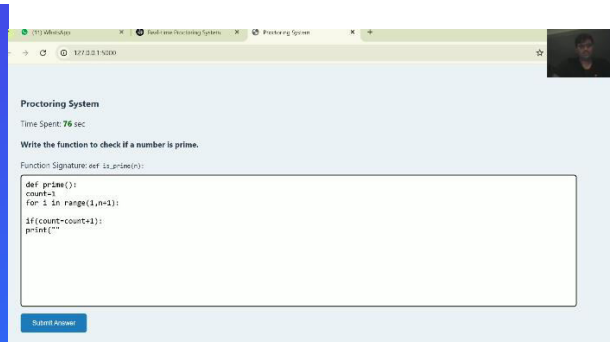

Fig: 2

```
------ TEST SUBMITTED AT 2025-05-04 19:28:46.207962 ------
Time Spent (sec): 150
Tab Switches: 3
Window Blurs: 5
Answer:
def prime():
count=1
for i in range(1,n+1):

count=count+1
if(count>2):
print("Its a Prime num")
else:
print("Not a Prime num")
```

Fig: 3

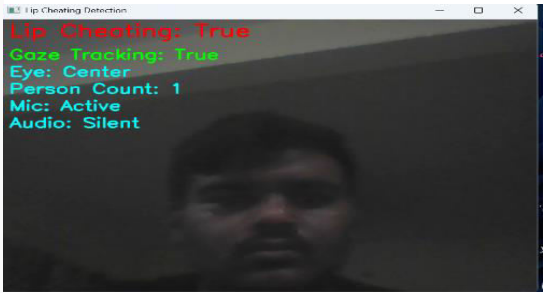

Fig: 4

User trials indicated that the system maintained consistent performance across varying lighting and network conditions, validating its suitability for remote and geographically diverse environments. Compared to traditional proctoring approaches, the proposed solution offered a higher degree of automation, reduced human bias, and improved scalability for mass deployments

VI. CONCLUSION

This project introduces an intelligent, AI-driven proctoring system that redefines the standards of surveillance in online examinations and virtual interviews. By leveraging advanced computer vision and deep learning models, the system delivers real-time monitoring through facial recognition, gaze estimation, lip-sync verification, and motion tracking—ensuring continuous assessment of candidate behaviour throughout the session.

Built using OpenCV, machine learning, and real-time audio-visual synchronization, the platform effectively identifies critical forms of malpractice, including identity fraud, off-screen distractions, and unauthorized assistance. The integration of lip-audio consistency analysis adds another layer of speech authenticity validation, reinforcing the credibility of the monitoring process.

Designed to be scalable, reliable, and non-intrusive, the system fosters a transparent and secure remote assessment environment. It not only mitigates risks of dishonesty but also instils confidence among institutions and candidates—ensuring fairness, integrity, and trust in digital evaluations.

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VII. FUTURE WORK

The smart surveillance system is poised for significant enhancements to evolve into a more intelligent, accessible, and scalable platform for remote proctoring. Future development aims to incorporate **emotion recognition** algorithms to assess candidate stress levels and detect suspicious emotional cues, providing deeper behavioural insights. The addition of **speaker verification** will fortify voice-based authentication and prevent misuse through voice surrogates.

To meet the demands of large-scale virtual assessments, a **cloud-hosted deployment** is envisioned, offering scalable infrastructure for seamless monitoring across institutions. Expanding compatibility to **mobile platforms (Android/iOS)** will ensure accessibility and remote invigilation even in bandwidth-constrained or mobile-first environments.

A major advancement includes integrating **biometric verification**—such as fingerprint or iris scans—with facial recognition to enhance the reliability of identity validation. Further, the system will feature a **post-session reporting dashboard**, enabling examiners to review detailed behavioural analytics and event logs for comprehensive post-exam evaluations.

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