Joint Crypto-Blockchain Scheme for Trust-Enabled CCTV Videos Sharing

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RESEARCH QUESTIONS

RQ1: Does the selective encryption serve the purpose of Data Protection Regulation compliant privacy protection of monitored individuals by CCTV cameras?

RQ2: What information can be helpful for the validation of visual data using chain-of-evidence in remote court services?

RQ3: Do the remotely conducted courts consider the presented CCTV footage trustworthy for legal decision making?

CONTRIBUTIONS

C1: A prototype is developed for trust-enabled sharing of encrypted CCTV recorded videos, which are presented as evidence in the court hearings for legal purposes.

C2: Foreground motion of the video datasets is detected through Gaussian Mixture Model (GMM) and then the privacy is achieved by applying reversible eXclusive-OR (XOR) encryption on the detected information.

C3: Permissioned blockchain is incorporated for authentic chain-of-evidence management using Hyperledger Fabric.

METHODOLOGY

1. Selective encryption is applied on the selected parts (moving objects) of session wise captured videos. The session is considered for an hour; so, there are 24 sessions in a day to cater for the lightening conditions.
2. Calculation of hash value on original videos captured per hour session.
3. Storage of the hash values (calculated on a session video) in blockchain (Hyperledger Fabric) along with video metadata.
4. Storage of ROI based encrypted videos and ROI based encrypted masks on two off-chain storage mediums i.e., using wallet for storing encrypted masks and edge storage for encrypted videos.

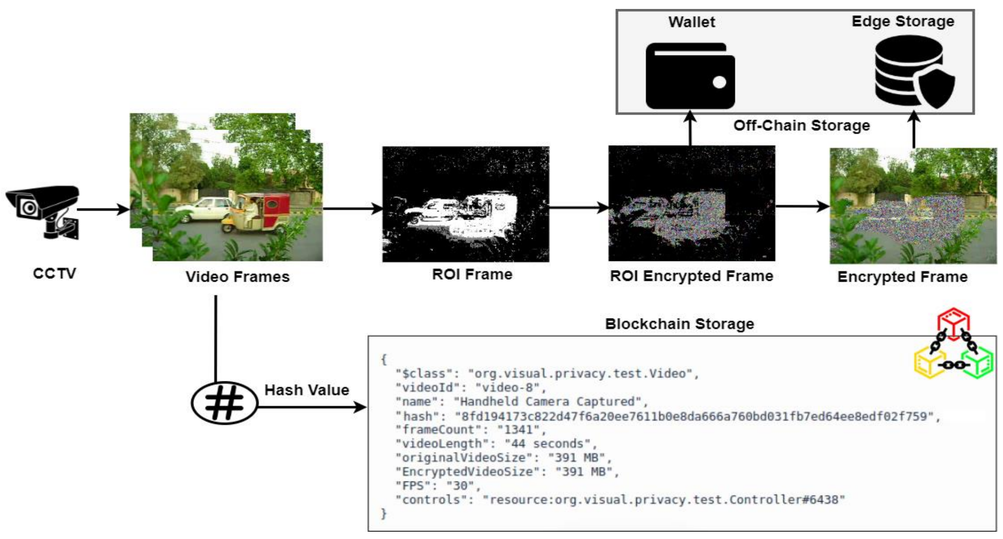

Fig. 1. Proposed Solution

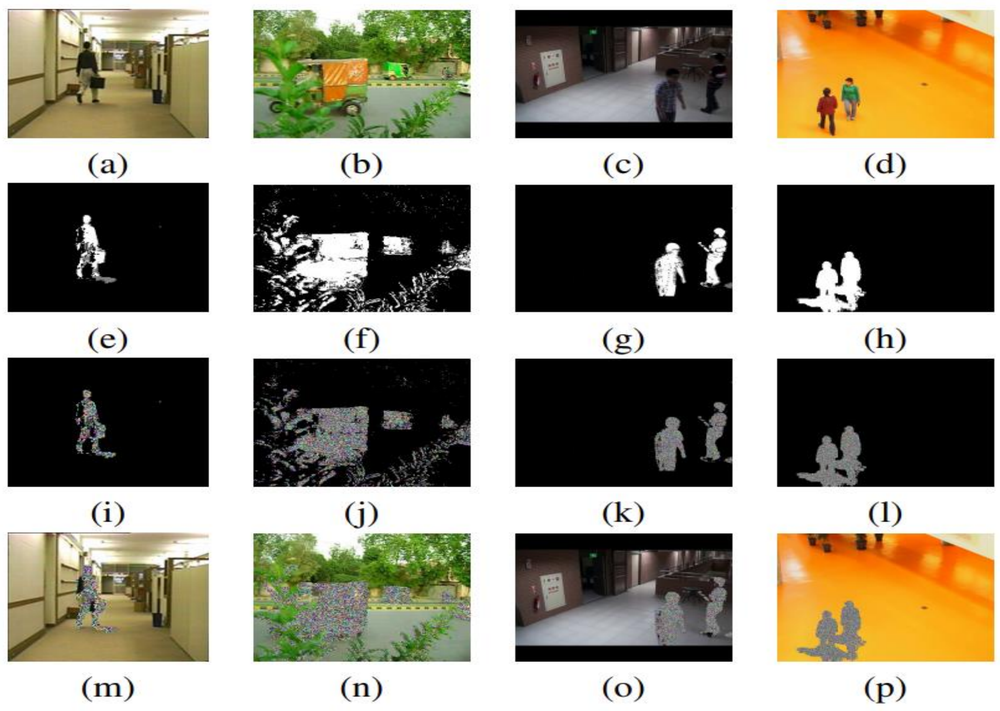

Fig. 2. Original Frames (a) - (d), ROI Masked Frames (e) - (h), ROI Masked Encrypted Frames (i) - (l), and Encrypted Frames (m) - (p).

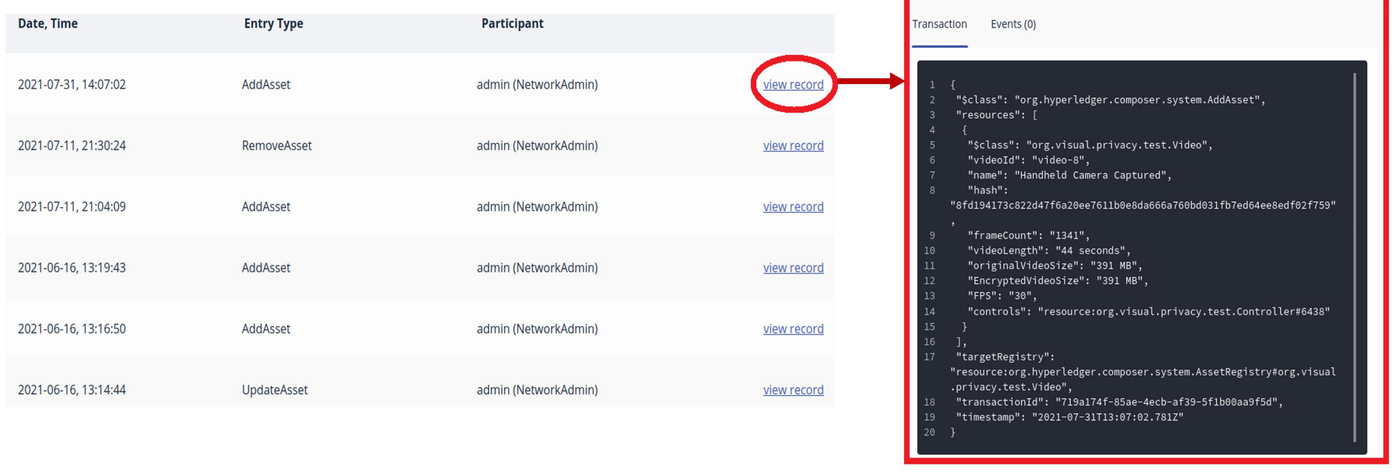

Fig. 3. Chain-of-Evidence

COMPUTATIONAL ANALYSIS

The computational time for calculating the hash value is dependent on varying characteristics i.e., file size, frame rate, color, and motion information etc., so it is different for each video.

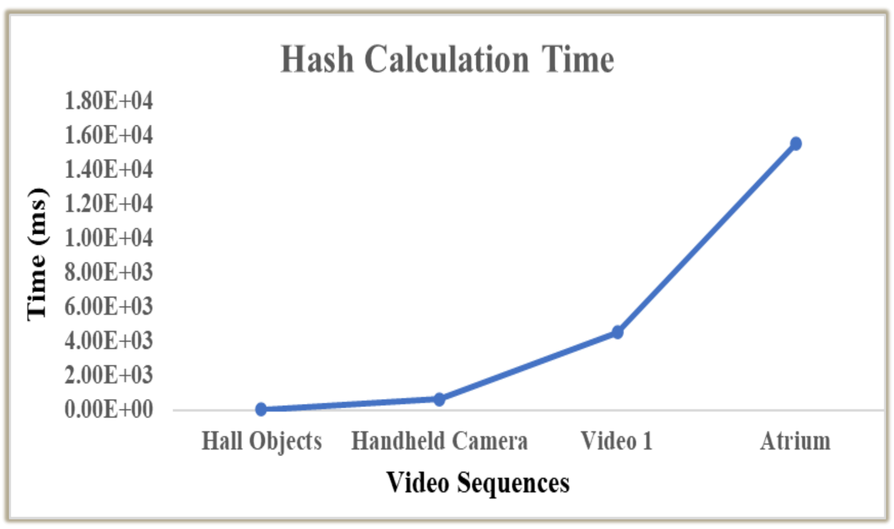

Fig. 4. Computational Analysis.

Table. 1. Comparative Analysis

Year	Application	Authentication	Blockchain	Security
2018	Smart Cities	Hash	Permissioned	Nil
2018	Nil	Hash	Unmentioned	DCT
2019	Forensic Investigation	MD5 Hash	Hyperledger	Nil
2020	Smart Cities	Nil	Hyperledger Fabric	Nil
2021	Remote Court Hearings	SHA-256	Hyperledger Fabric	Selective Encryption

CONCLUSION AND FUTURE WORK

This research has shown a joint protection and authentication scheme for CCTV videos using cryptography and blockchain. In compliance with Data Protection Regulations, data must be stored in encrypted form so that the identity of individuals should be protected.

In future, the proposed system can be extended for testing live-captured CCTV videos along with moving cameras (dash-cams, bodycams and drones) and automatic creation of new assets (video metadata) in the blockchain.

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