US 20240005042A1

(19) **United States**

(12) **Patent Application Publication**

Earles et al.

(10) **Pub. No.: US 2024/0005042 A1**

(43) **Pub. Date: Jan. 4, 2024**

(54) **DASHBOARD CAMERA AND ASSOCIATED CLOUD STORAGE SERVICE HAVING INTEGRATED FILE VALIDATION**

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(21) Appl. No.: **18/216,403**

(22) Filed: **Jun. 29, 2023**

Related U.S. Application Data

(60) Provisional application No. 63/356,823, filed on Jun. 29, 2022.

Publication Classification

(51) **Int. Cl.**

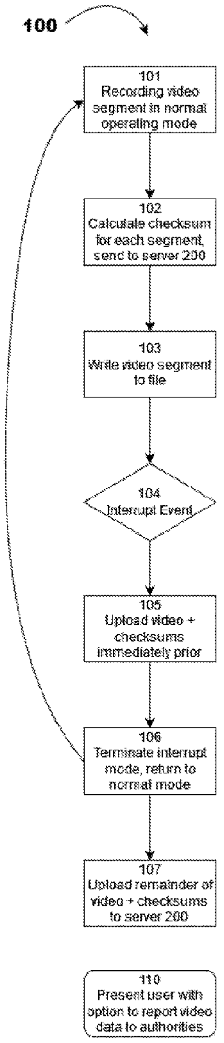
G06F 21/64	(2006.01)
H04N 5/76	(2006.01)
G06F 21/60	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 21/64*** (2013.01); ***H04N 5/76*** (2013.01); *G06V 20/40* (2022.01); *G06V 2201/10* (2022.01); ***G06F 21/602*** (2013.01)

(57) **ABSTRACT**

A system and method for recording, backing up, and authenticating footage from a dash cam or other video device comprises continuously synchronizing checksums from segments of video as they are recorded into rolling storage with an authentication server located remotely. Only metadata is uploaded until the video device experiences an interrupt event, at which point the last few rolling segments, as well as subsequent rolling segments until the termination of the interrupt event, are written to persistent storage and uploaded to the authentication server at the earliest opportunity. The metadata and video are encrypted with an asymmetric public/private key system enabling third parties to confirm, with the public key, that the metadata on the recording device and the authentication server match, and with the private key, download the video footage from the interrupt event.


100
101 Recording video segment in normal operating mode
102 Calculate checksum for each segment, send to server 200
103 Write video segment to file
104 Interrupt Event
105 Upload video + checksums immediately prior
106 Terminate interrupt mode, return to normal mode
107 Upload remainder of video + checksums to server 200
110 Present user with option to report video data to authorities

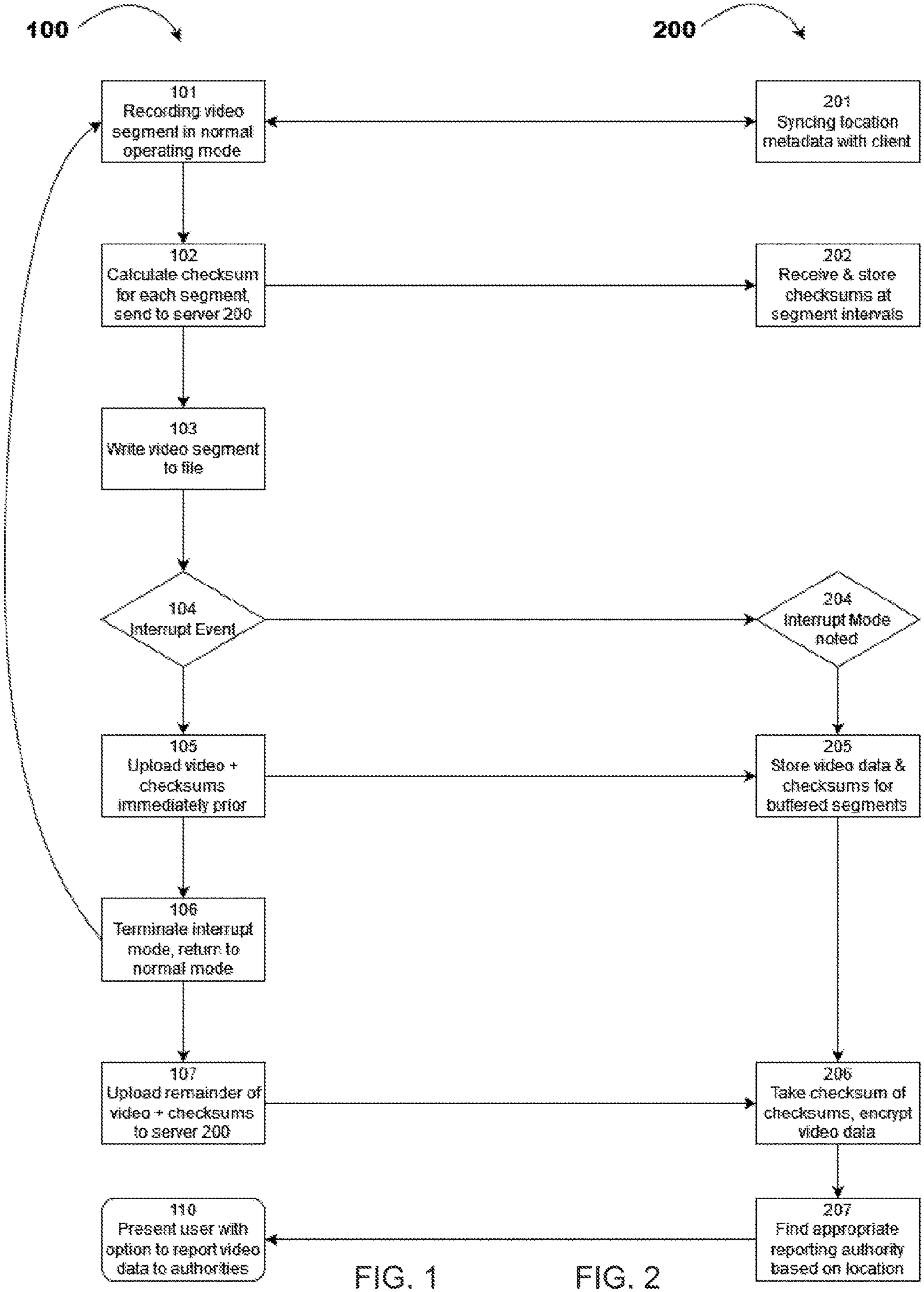

100
200
101
Recording video segment in normal operating mode
201
Syncing location metadata with client
102
Calculate checksum for each segment, send to server 200
202
Receive & store checksums at segment intervals
103
Write video segment to file
104
Interrupt Event
204
Interrupt Mode noted
105
Upload video + checksums immediately prior
205
Store video data & checksums for buffered segments
106
Terminate interrupt mode, return to normal mode
107
Upload remainder of video + checksums to server 200
206
Take checksum of checksums, encrypt video data
110
Present user with option to report video data to authorities
207
Find appropriate reporting authority based on location

FIG. 1

FIG. 2

DASHBOARD CAMERA AND ASSOCIATED CLOUD STORAGE SERVICE HAVING INTEGRATED FILE VALIDATION

REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a non-provisional utility patent application claiming priority to provisional patent application No. 63/356,823, filed 29 Jun. 2022 and having the same title and inventors. The contents of the above-referenced application are incorporated by reference.

FIELD

[0002] Embodiments usable within the scope of the present disclosure relate, generally, to an improved dashboard camera for use in a vehicle which automatically digitally encrypts captured video files. The encrypted file is then uploaded to a witnessing service which uses a private key to encrypt the file along with metadata including a time stamp, a location, and a checksum file, as well as a list of public keys. This creates and preserves a chain of custody in the video which can be verified by anyone (including law enforcement) and ensures that no video or metadata in the file has been altered.

BACKGROUND

[0003] Dashboard cameras are commonly used by both private and commercial drivers to establish video evidence in the event of an accident, with applications ranging from simple civil liability to criminal road rage incidents. However, these cameras often simply function by writing the last 60 seconds or so of footage to a file which is then stored on either an internal disk (e.g., flash memory) or to a cloud-based service.

[0004] The proliferation of video capture in day-to-day life has been accompanied by an increased risk of video manipulation. While in the past such alterations to dash cam videos might have been easy to spot, recent advancements in machine learning and consumer-grade video editing have made it more feasible for bad actors to selectively cut or even alter footage, and these technologies will only get more powerful and accessible.

[0005] A need therefore exists for a system which can ensure that any video footage which is intended to be presented as evidence in a legal dispute has a settled chain of custody, so the driver, law enforcement, and judicial systems can be confident that the video file represents raw capture from a dashboard camera and has not been altered in any way, while still preserving the privacy of the actual data from being viewed by parties other than authorized law enforcement investigators.

[0006] Embodiments of the invention described herein meet this and other needs.

SUMMARY

[0007] The invention comprises a software application (app) which may be run on a camera, phone, or any multimedia recording device capable of video capture and storage (including software running via SD card interface) which records and uploads a digital "fingerprint" of media (e.g., a cryptographic checksum) on a rolling basis as it is being written. In the event of an accident, the footage immediately preceding and following the event is moved from rolling storage to persistent storage, "signed" via asymmetric cryptography and uploaded to an attestation server with relevant metadata as well as the video data itself. This allows any third party with the public key to compare their own copy of the file and compare it to the checksum of the present on the attestation server. Because the data is attested on a rolling basis, neither the user nor the server can alter or edit the video footage without causing the checksums to mismatch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In the detailed description of the embodiments, presented below, reference is made to the accompanying drawings:

[0009] FIG. **1** depicts a client-side flowchart for the app as it controls the user's camera.

[0010] FIG. **2** depicts a server-side flowchart for the attestation server.

[0011] One or more embodiments are described below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0012] Before describing selected embodiments of the present disclosure in detail, it is to be understood that the present invention is not limited to the particular embodiments described herein. The disclosure and description herein is illustrative and explanatory of one or more presently preferred embodiments and variations thereof, and it will be appreciated by those skilled in the art that various changes in the design, organization, order of operation, means of operation, equipment structures and location, methodology, and use of mechanical equivalents may be made without departing from the spirit of the invention.

[0013] As well, it should be understood the drawings are intended to illustrate and plainly disclose presently preferred embodiments to one of skill in the art, but are not intended to be manufacturing level drawings or renditions of final products and may include simplified conceptual views as desired for easier and quicker understanding or explanation. As well, the relative size and arrangement of the components may differ from that shown and still operate within the spirit of the invention.

[0014] Moreover, it will be understood that various directions such as "upper," "lower," "bottom," "top," "left," "right," and so forth are made only with respect to explanation in conjunction with the drawings, and that the components may be oriented differently, for instance, during transportation and manufacturing as well as operation. Because many varying and different embodiments may be made within the scope of the concept(s) herein taught, and because many modifications may be made in the embodiments described herein, it is to be understood that the details herein are to be interpreted as illustrative and non-limiting.

[0015] Turning first to FIG. **1**, a flowchart is shown for the client side **100** of an embodiment of the software to be run on any suitable video capture device, including dashboard-mounted phone, dashboard camera, or combinations and equivalents thereof (e.g., an embodiment may run the software on a phone for processing the video, but record the video from an aftermarket dashcam connected to the phone rather than the phone's camera, using the storage of one or both devices). In an embodiment, the video capture device comprises both rolling and persistent memory; these may be separate physical storage mediums entirely (e.g., an SD card and internal flash drive), or they may be software-based partitions or directories of a single physical storage medium. In one embodiment, the persistent storage is "write-only" memory which cannot be modified and/or cannot be deleted without formatting or resetting the device.

[0016] In standard operating flow, the software receives segments of video **101**, which it then processes in segments **102** (which may be of any suitable length depending on the processing power and bandwidth of the hardware). As the segments are processed and stored in rolling memory, a "checksum" is calculated for each segment, where the data includes both the video footage itself as well as metadata including location, time, etc., as well as a "signature" (which may be enabled via private-key cryptography) from the web service **200** (shown in more detail in FIG. **2**). In an embodiment, the checksum may be a cryptographic checksum.

[0017] Since it is not practical or desirable for a dashboard camera to stream footage constantly to a server, in normal operating mode, the software instead syncs only the metadata (i.e., the checksums of each video segment) with the web service **200**. The checksums of each video segment represent a fingerprint of the data, which can be compared between server and client to ensure the data has not been altered. Only after the checksum is created are the files then written to the rolling memory within the client device **103**.

[0018] When an interrupting event **104** occurs, the client system **100** enters an interrupt mode where the last few segments of video data in the rolling storage (as well as subsequent segments of video data) are moved to persistent storage and uploaded to the web service **200** alongside the checksums **105**. An interrupting event **104** may be automatically triggered (e.g., by accelerometers, which are commonly built into smartphones, detecting a sudden drop in velocity) or the event may be initiated by a user (e.g., in the event of a confrontation in a parking lot where no sudden change in velocity may he apparent).

[0019] Similarly, the duration of the upload initiated after the interrupting event **104** may be either a predetermined length of time (e.g., five minutes subsequent to the interrupting event), or may be terminated based on the absence of a triggering condition, or by the user's manual command. Regardless of the duration, during interrupt mode, the client will continue to persistently record both video and metadata until the system **100** returns to standard operating flow **106**. Once standard operating mode is resumed, the files, metadata, and checksums recorded during the interrupt mode are uploaded to the server **107** at the earliest opportunity (if sufficient bandwidth is available, this upload may happen in real-time, or if the interrupting event took place without sufficient wireless data coverage, when the device is back in range of such).

[0020] Turning now to FIG. **2**, the web service **200** syncs with the client device (i.e., the video capture device) to record the location of the device **201** and receives a series of video segment checksums from the client-side device during standard operating flow **202**. When the client-side notes an interrupting event **104** and begins sending video, the web service **200** then enters a corresponding interrupt mode **204** where the checksums and video files are received and stored on the server for both the buffered segments immediately prior to the event **205** as well as the segments received shortly after the event **206**. Once the interrupt mode is terminated, the web service **200** then encrypts the segments, calculating a "full signature" (e.g., a checksum of checksums) for the segments comprising the buffer duration before and after the interrupting event **204**, and then returns to normal operating flow.

[0021] If, in a future legal dispute, the user's client-side files are entered into evidence, this "full signature" can also be re-calculated from the files on the client side persistent memory, and compared with the full signature from the server side. If any alterations are made, the checksums will no longer match, and the file will be flagged as invalid.

[0022] In an embodiment, the client-side **100** and server-side **200** may utilize asymmetric cryptography wherein the client-side **100** encrypts the metadata utilizing a public encryption key corresponding to a private decryption key available only to the server-side software **200**. The server-side software may then return a valid/invalid comparison to any approved third-party (e.g., an investigating agency) with the public key while still not enabling decryption or viewing of the actual video footage.

[0023] In another embodiment, the client-side software **100** may assist the user in filing a report on the incident with law enforcement and/or insurance **110**. This could be done by, e.g., using the location data recorded as part of the video segments to locate a jurisdiction with authority over the incident, using insurance information configured by the user during setup, pre-generating a report form appropriate to that jurisdiction, and/or including a link to the files located on the server-side, where the client can authorize release of the video to law enforcement. Since the checksums are calculated and synced prior to being written to the local persistent storage, law enforcement can then view the footage directly from the server without first needing to take custody of the user's client-side device (which may be more convenient, e.g., if the user was traveling out of town).

[0024] In still another embodiment, the server-side software **200** may also comprise a digital character recognition engine for alphanumeric license plate strings. When the system is actively recording, the footage can be analyzed to yield visible license plates as metadata, which can then be directly sent to law enforcement alongside the video itself.

[0025] Although several preferred embodiments of the invention have been illustrated in the accompanying drawings and described in the foregoing specification, it will be understood by those of skill in the art that additional embodiments, modifications and alterations may be constructed from the invention principles disclosed herein, while still falling within the scope of the disclosed invention.

1. A method for independently authenticating video footage following and immediately preceding an interrupt event, the method comprising:

recording sequential segments of video footage on a video capture device, the video capture device comprising a wireless internet connection, rolling storage, and permanent storage, and the video footage comprising location metadata, date/time metadata, and checksum metadata;

for each sequential segment of video footage, synchronizing the location metadata, the date/time metadata, and the checksum metadata with a server;

simultaneously writing the sequential segments of video footage to the rolling storage;

engaging an interrupt mode when an interrupt event is detected, and transmitting the location metadata and date/time metadata associated with the interrupt event to the server;

when the interrupt mode is engaged, copying the sequential segments of video footage written to rolling storage to the permanent storage;

while the interrupt mode is engaged, writing subsequent sequential segments of video footage to the permanent storage;

when. the interrupt mode is terminated, uploading the sequential segments of video footage recorded while in interrupt mode to the server, while resuming the rolling storage of sequential segments of video footage;

encrypting, with the server, the sequential segments of video footage with a private key; and

encrypting, with the server, the metadata. corresponding to the sequential segments of video footage with a public key corresponding to the private key.

2. The method of claim **1**, further comprising the step of:

decrypting, with the server, the metadata corresponding to the sequential segments of video footage when requested with the public key.

3. The method of claim **1**, wherein the persistent storage is write-only.

4. The method of claim **1**, wherein the video footage further comprises license plate metadata derived from optical character recognition of video frames.

5. The method of claim **1**, further comprising the steps of:

when the interrupt mode is terminated, selecting a reporting agency based on the location metadata and date/time metadata; and

generating a report of the interrupt event, including the public key, for the user to submit to the reporting agency.

6. The method of claim **5**, wherein the report includes the private key, enabling decryption of the video files by the reporting agency.

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