Mobile steganography: Looking to the future

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Overview

- What is steganography and steganalysis

- Motivation for the use of mobile steganography and for a mobile app database

- How a mobile stego app works

- Example of steganography embedding algorithm (LSB)

- How to to create a mobile steg image database using stego apps

- Data in StegoAppDB

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What is steganography? *Hiding in plain sight*

- **Steganography**: to send a message camouflaged inside an ordinary-looking object so it avoids suspicion of covert communication

- **Goal:** make payload visually and statistically undetectable so there is no evidence of communication

message

CLASSIFIED

input

input

Mobile Steg app

output

Stego image

Steg Detection
= **Steganalysis**
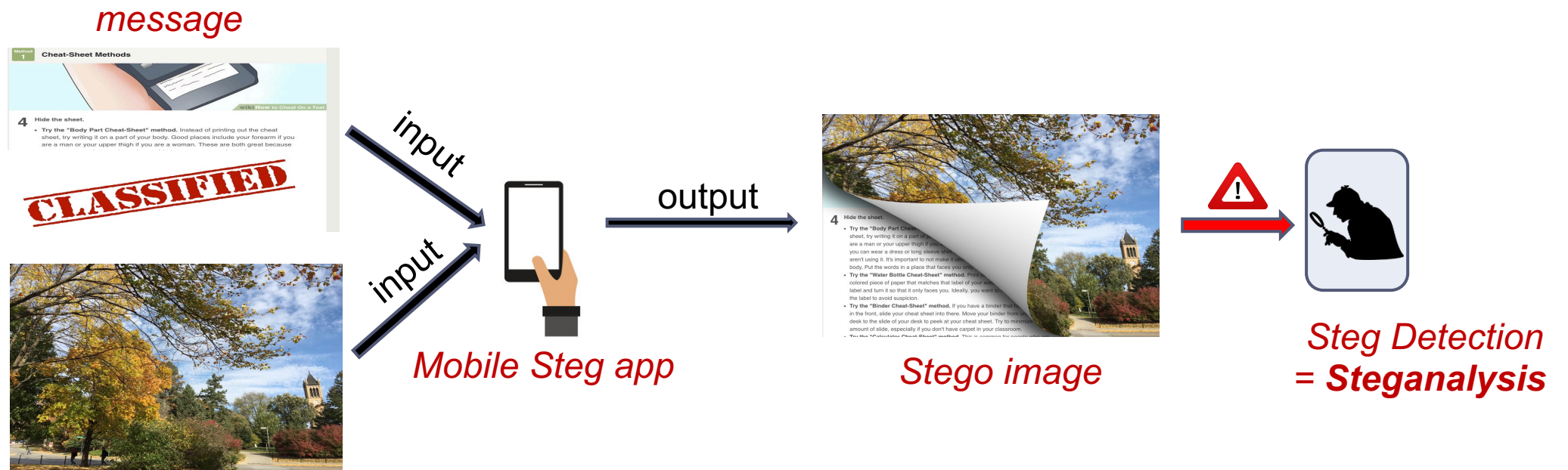
Innocent or cover image

Motivation to work with mobile steganography

- Steganography is used to promote these types of threats:

- In National / Foreign intelligence acts

- Stealing intellectual property

- Pornography acts

- Spying

- Communication for criminal activity

- Hide notes & files, etc. from illegal activities such as off the book financial transactions, etc.

Motivation to create a mobile steganography data set

- Steganography is used to promote these types of threats:

- In National / Foreign intelligence acts
- Stealing intellectual property
- Pornography acts
- Spying
- Communication for criminal activity
- Hide notes & files, etc. from illegal activities such as off the book financial transactions, etc.

- A smartphone offers advantages that computers don't have:

  - Ease of use
  - Low level of skill needed to use

- Need a special data set to learn how mobile steganography works
- *StegoAppDB**

*StegoAppDB: A steganography apps forensics image database," IS&T Int'l. Symp. on Electronic Imaging, Media Watermarking, Security, and Forensics 2019, Burlingame, CA, pp. 536-1-536-12 (12), 2019.

Link for StegoAppDB: https://forensicstats.org/data/

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Scenario: How using a mobile stego app works

- Alice wants to send a secret message to Bob
  - Downloads mobile stego app onto smartphone and opens it
  - Chooses a photo
  - Types in secret message
  - The app produces a stego image visually indistinguishable from the original
- Sends to Bob
  - Uses same app to extract the hidden message
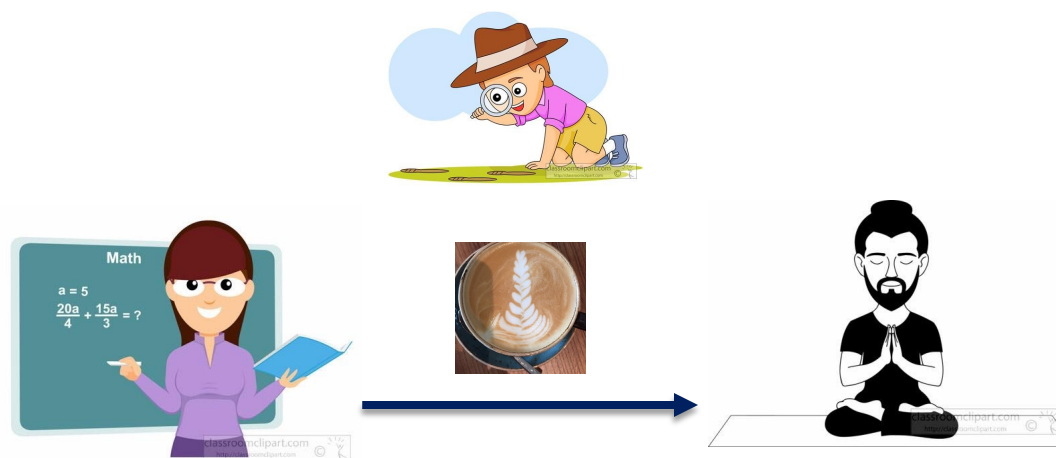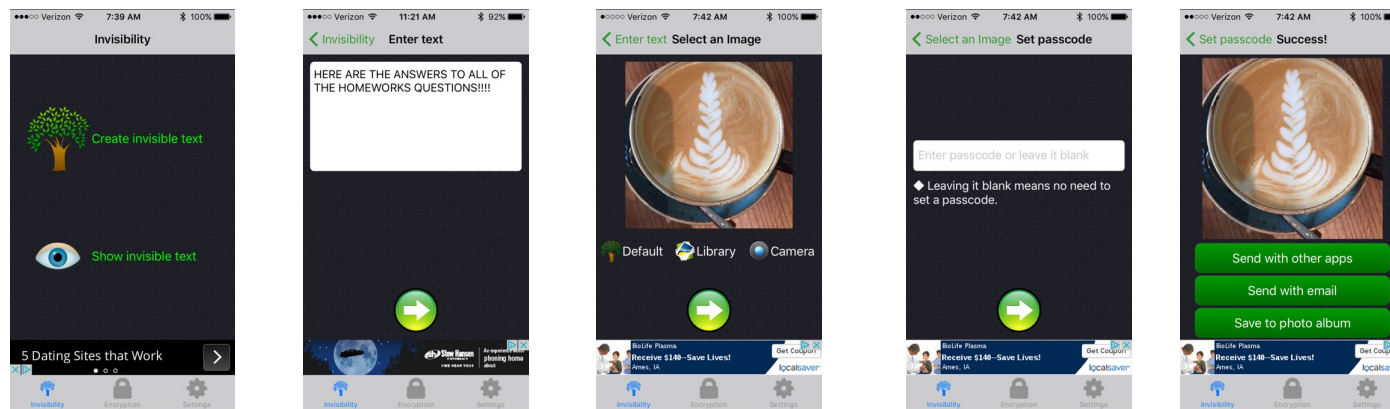
Key questions

- Alice wants to send a secret message to Bob
  - Downloads mobile stego app onto smartphone and opens it
  - Chooses a photo
  - Types in secret message
  - The app produces a stego image visually indistinguishable from the original
- Send to Bob
  - Uses same app to extract the hidden message
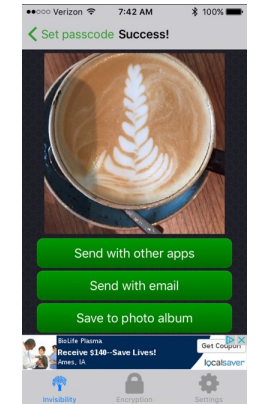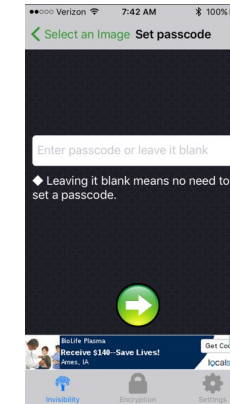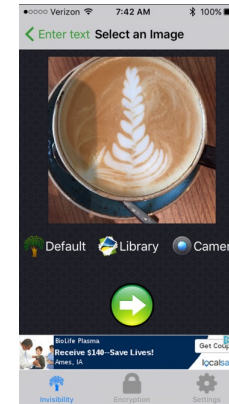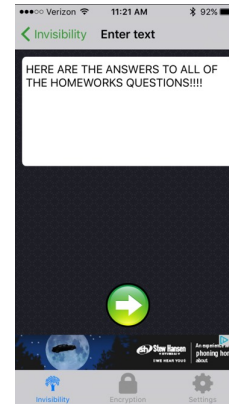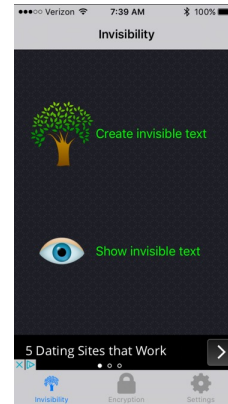
- How to detect these kinds of stego images?
- Can we extract messages?

Some Popular Steganography Apps on Google Play

| App Name | Installs | Open Source | Output Format | Image Resizing | Payload Pre-processing | | | Embedding Technique |
					Encryption	Signature Strings	Length Data	
PixelKnot	100,000+	Yes	JPG	Downsampling	Yes	No	Yes	F5
Steganography Master	10,000+	No	PNG	No	No	Yes	No	1's digit replacement
Steganography_M	10,000+	No	PNG	No	No	Yes	No	LSB replacement
DaVinci Secret Image	5,000+	No	PNG	User specified	No	Yes	Yes	Alpha channel encoding
Steganography_T	5,000+	No	PNG	No	No	No	Yes	LSB replacement
Stegais	1,000+	No	JPG	Downsampling	No	No	Yes	Unknown
PocketStego	1,000+	No	PNG	Downsampling	No	Yes	No	LSB
MobiStego	1,000+	Yes	PNG	Downsampling	Yes	Yes	No	RGB channels LS2B
NiaStego	1,000+	No	PNG	Upsampling	Yes	Yes	No	RGB channels LSB
Passlok	1,000+	Yes	JPG	No	Yes	Yes	No	Non-shrinkage F5
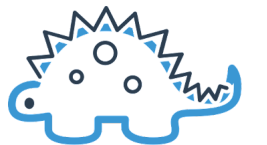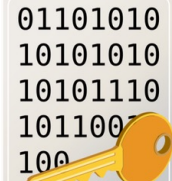
Design criteria for StegoAppDB database: a Digital Evidence Data Set

- *To be useful in a forensic context:*
  - o **Authentication**: Provenance for each image
  - o **Representation:** Includes practical representatives found in crime cases
  - o **Evaluation:** Data can evaluate and benchmark algorithms
  - o **Free public access, no copyright or privacy issues**

- *Types of variety useful in this steganography database*
  1. Variety of embedding algorithms / apps
  2. Variety of smartphones (models, devices) where apps execute (Android, iOS)
  3. Variety of different images
  4. Variety of message sizes
  5. Actual stego images

How to create a forensically useful stego data set

28 devices, 10 models
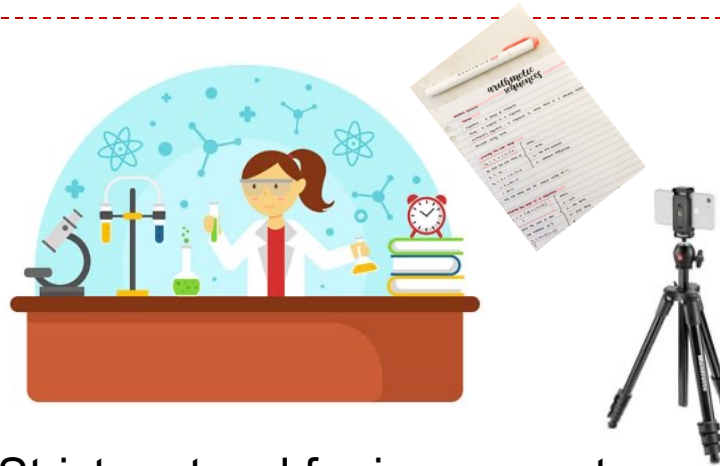
Strict protocol for image capture
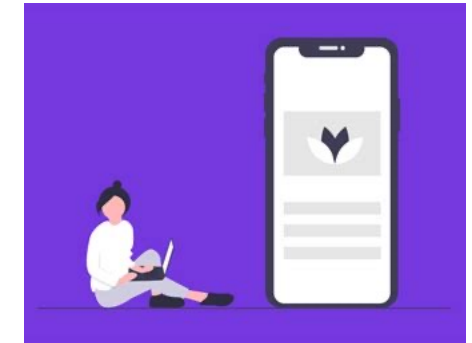
Created own *Cameraw* app to collect photos

Take many photos
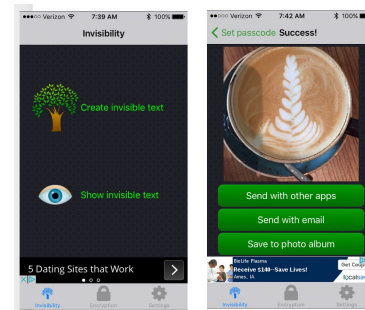
Create many stego images using mobile stego apps

Verify all data and code

All provenance information available with each download

Example of steganography embedding algorithm: LSB Replacement embedding

Pixel value 106 represented by 8 bits

The 8 bit-planes of an 8-bit image (grayscale)

MSB = <u>M</u>ost <u>S</u>ignificant <u>B</u>it

LSB = <u>L</u>east <u>S</u>ignificant <u>B</u>it

$$106 = \begin{matrix} 0 \\ 1 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \end{matrix}$$

MSB plane

LSB plane
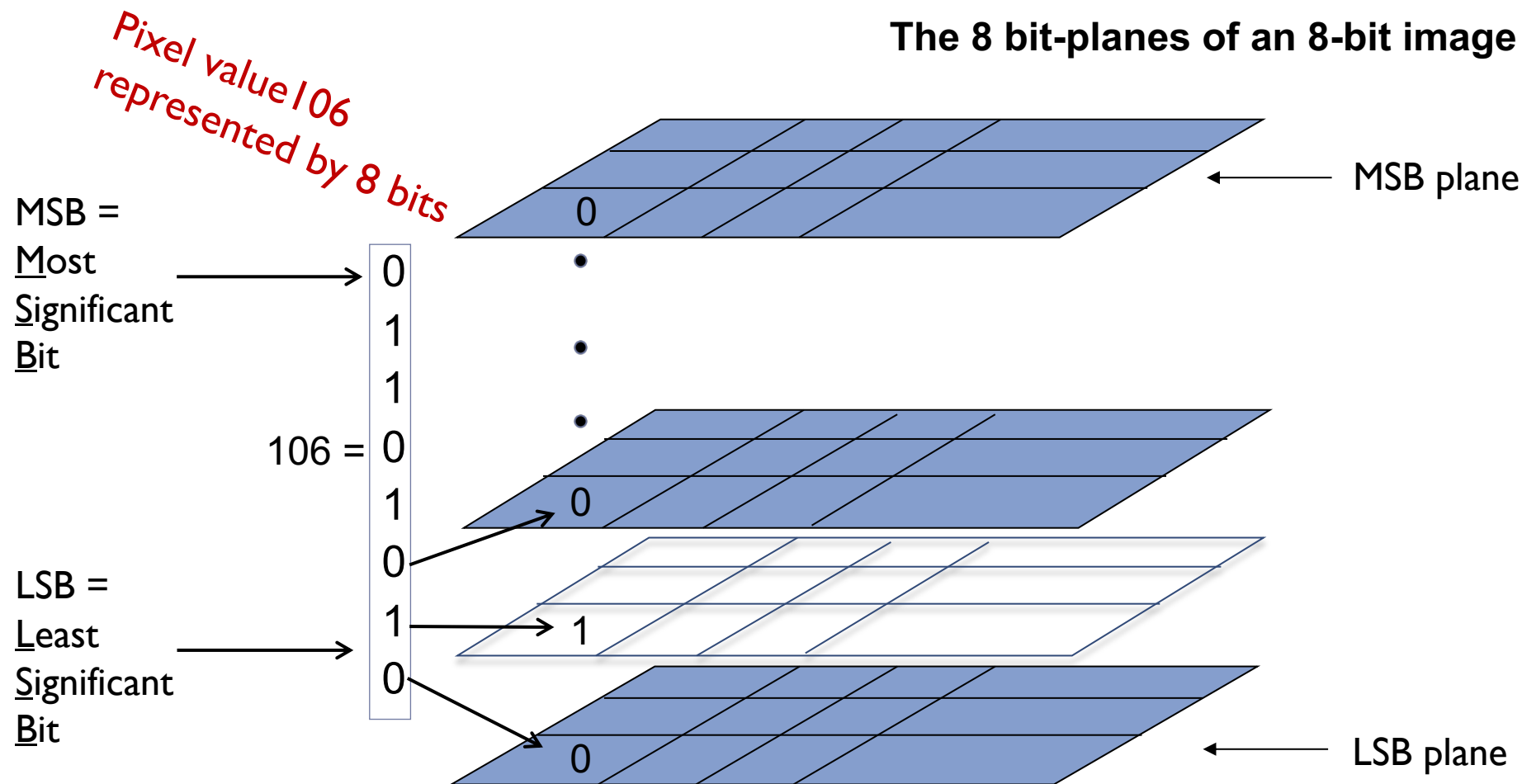
Example: Steganography embedding algorithm
LSB Replacement

Cover image: no message

230	229	232	234	235	232	148
237	236	236	234	233	234	152
255	255	255	251	230	236	161
99	90	67	37	94	247	130
222	152	255	129	129	246	132
154	199	255	150	189	241	147
216	132	162	163	170	239	122

Cover image values

- Take a grayscale image and observe its LSB plane

0	1	0	0	1	0	0
1	0	0	0	1	0	0
1	1	1	1	0	0	1
1	0	1	1	0	1	0
0	0	1	1	1	0	0
0	1	1	0	1	1	1
0	0	0	1	0	1	0

LSB values of cover image

LSB Replacement

Payload bit string: 010010000100010101010010010001010010000001000001010100...

230	229	232	234	235	232	148
237	236	236	234	233	234	152
255	255	255	251	230	236	161
99	90	67	37	94	247	130
222	152	255	129	129	246	132
154	199	255	150	189	241	147
216	132	162	163	170	239	122

Cover image values

- Take a grayscale image and observe its LSB plane
- Convert payload into sequence of binary bit values (0s and 1s) and form into array the size of the image

0	1	0	0	1	0	0
1	0	0	0	1	0	0
1	1	1	1	0	0	1
1	0	1	1	0	1	0
0	0	1	1	1	0	0
0	1	1	0	1	1	1
0	0	0	1	0	1	0

LSB values of cover image

1	0	1	1	1	0	1
0	1	0	1	1	0	1
1	1	0	0	1	1	0
0	1	0	0	0	1	1
1	0	1	1	0	1	0
1	1	0	0	1	1	1
0	1	1	1	0	0	0

Payload bits - array

LSB Replacement

230	229	232	234	235	232	148
237	236	236	234	233	234	152
255	255	255	251	230	236	161
99	90	67	37	94	247	130
222	152	255	129	129	246	132
154	199	255	150	189	241	147
216	132	162	163	170	239	122

Cover image values

231	228	233	235	235	232	149
236	237	236	235	233	234	153
255	255	254	250	231	237	160
98	91	66	36	94	247	131
223	152	255	129	128	247	132
155	199	254	150	189	241	147
216	133	163	163	170	238	122

Stego image values

0	1	0	0	1	0	0
1	0	0	0	1	0	0
1	1	1	1	0	0	1
1	0	1	1	0	1	0
0	0	1	1	1	0	0
0	1	1	0	1	1	1
0	0	0	1	0	1	0

LSB values of cover image

1	0	1	1	1	0	1
0	1	0	1	1	0	1
1	1	0	0	1	1	0
0	1	0	0	0	1	1
1	0	1	1	0	1	0
1	1	0	0	1	1	1
0	1	1	1	0	0	0

Payload bits - array

- Take a grayscale image and observe its LSB plane
- Convert payload into sequence of binary bit values (0s and 1s), uniformly distributed and form into array the size of the image
- Replace the (cover) image's LSB values with the payload bits
- The stego image's gray value is the (new) base-10 number if the LSB bit is changed

LSB Replacement

230	229	232	234	235	232	(148)
237	236	236	234	233	234	152
255	255	255	251	230	236	161
99	90	67	37	94	247	130
222	152	255	129	129	246	132
154	199	255	150	189	241	147
216	132	162	163	170	239	122

Cover image values

231	228	233	235	235	232	(149)
236	237	236	235	233	234	153
255	255	254	250	231	237	160
98	91	66	36	94	247	131
223	152	255	129	128	247	132
155	199	254	150	189	241	147
216	133	163	163	170	238	122

Stego image values

$$148 = \begin{matrix} 1 \\ 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 0 \end{matrix} \qquad 149 = \begin{matrix} 1 \\ 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \end{matrix}$$

LSB

cover   **stego**

0	1	0	0	1	0	(0)
1	0	0	0	1	0	0
1	1	1	1	0	0	1
1	0	1	1	0	1	0
0	0	1	1	1	0	0
0	1	1	0	1	1	1
0	0	0	1	0	1	0

LSB values of cover image

1	0	1	1	1	0	(1)
0	1	0	1	1	0	1
1	1	0	0	1	1	0
0	1	0	0	0	1	1
1	0	1	1	0	1	0
1	1	0	0	1	1	1
0	1	1	1	0	0	0

Payload bits - array

- LSB replacement simply overwrites the existing bit with the payload bit

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Why do we need stego images?
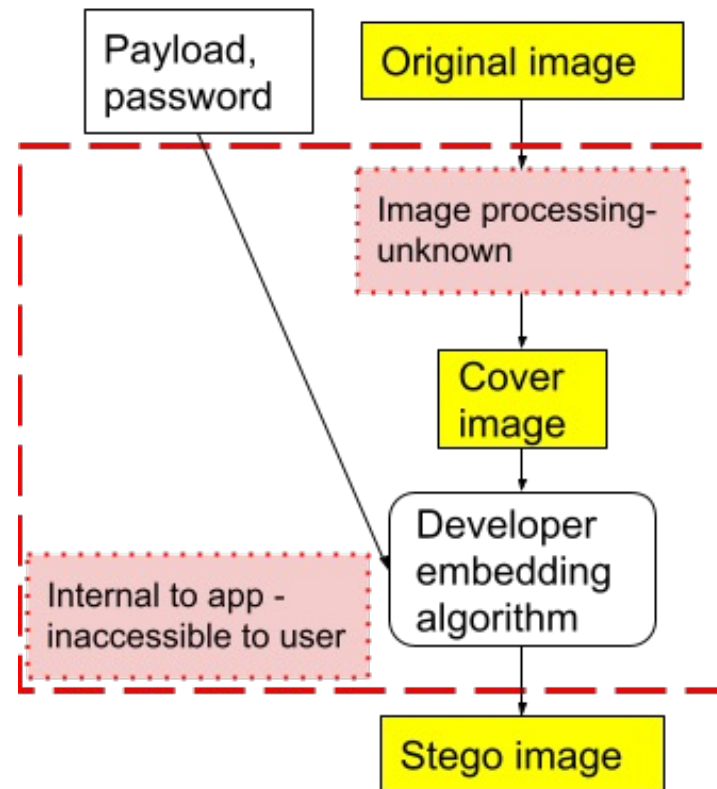# To Do Steg Detection/Steganalysis: Machine Learning

- Steganalysis Machine Learning (ML) algorithms need training pairs
  - One cover image (no message), and corresponding stego image with hidden message
- Use pairs to train ML algorithm to "learn" difference between *cover* and *stego*
- Test with other data, pass through ML algorithm, get output, determine the error rate

Training Phase:
Training data in pairs
(known, generated by user)

Cover image

Stego image

Train Machine Learning Parameters

Known error rate on training data

Testing Phase:
Class of Data Unknown

test image → ML → Output: cover or stego
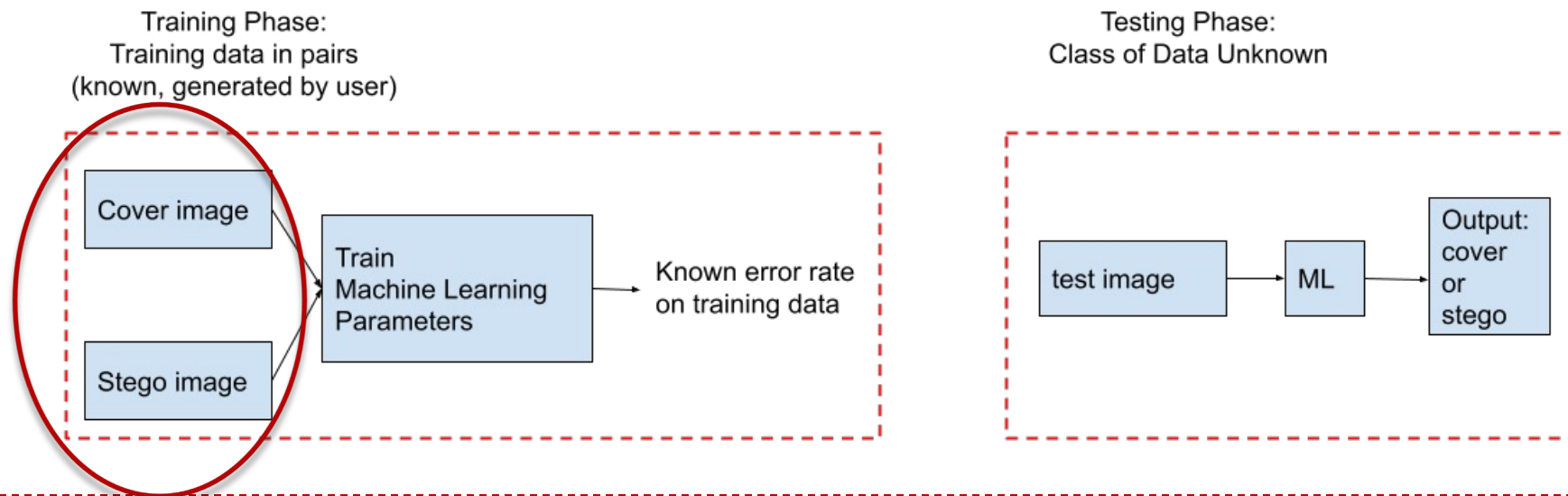
How a stego app works on a smartphone

- Input an original, clean image from the gallery or camera

- Input password (optional)

- The app outputs the stego image

- What happens internal to the app is unknown except to the developer of the app

- **Note the "cover image" is internal to the app**

How a stego app works on a smartphone

With no access to cover images, Machine Learning is not possible

- Input an original, clean image from the gallery or camera

- Input password (optional)

- The app outputs the stego image

- What happens internal to the app is unknown except to the developer of the app

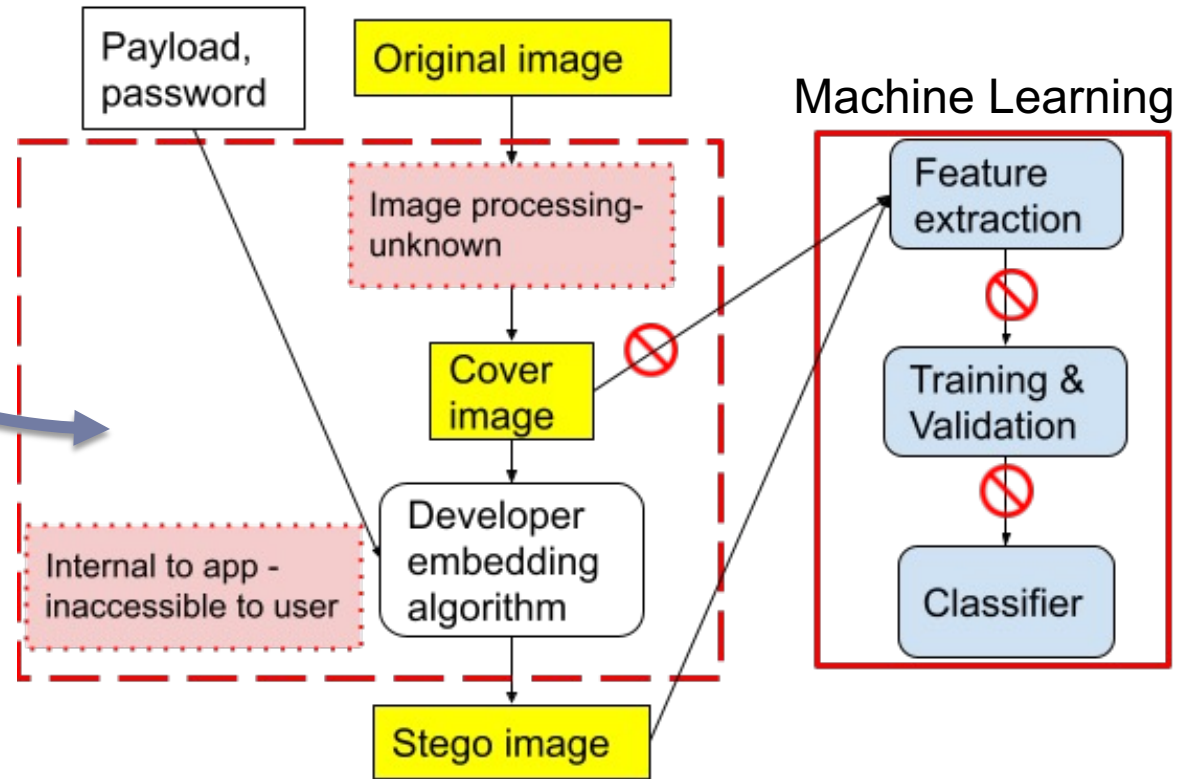- **Note the "cover image" is internal to the app**
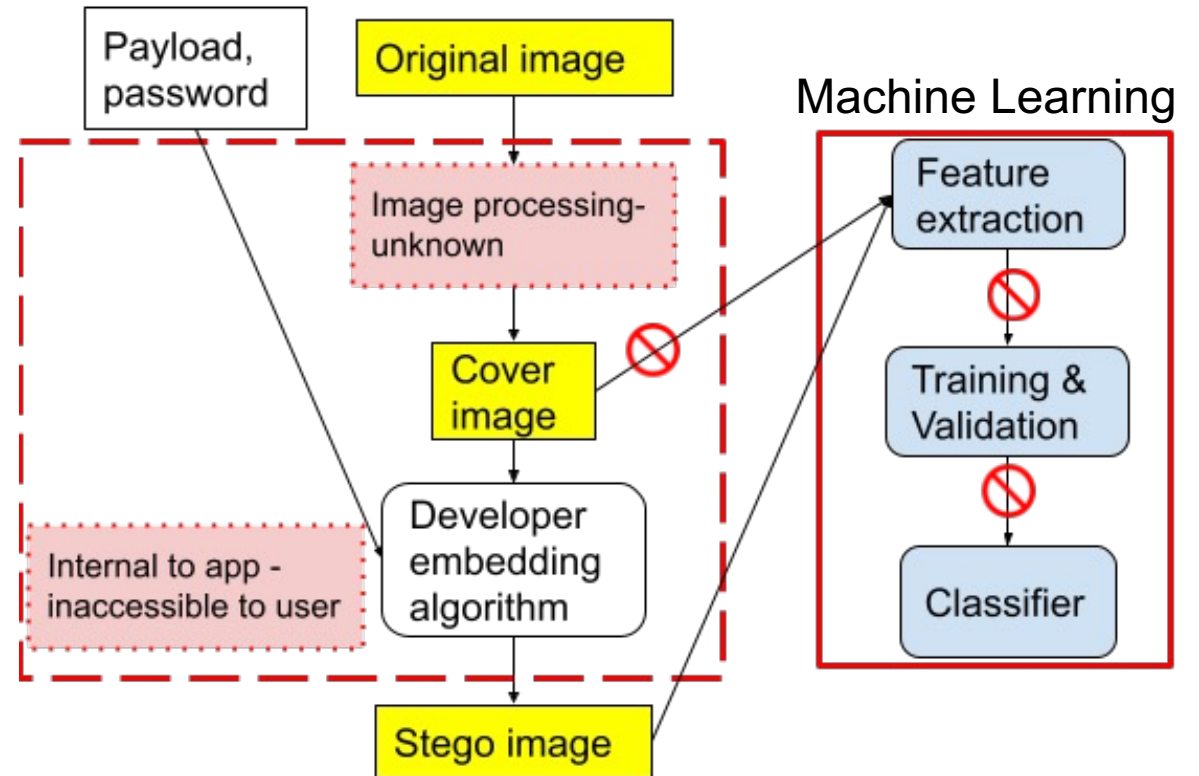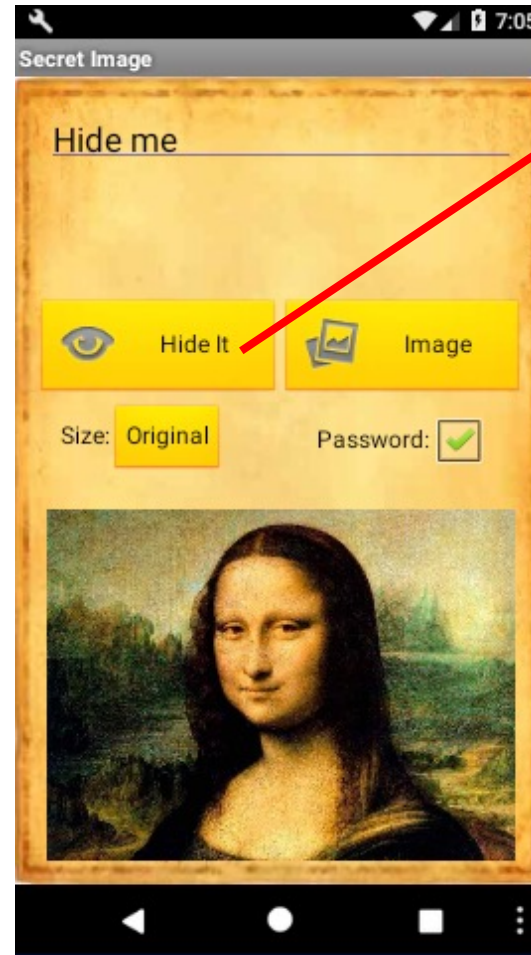
How to create stego images using mobile apps?

- ***Answer:***

- We get inside the developer's code by reverse-engineering several android apps

- This way, we can generate the cover image – stego image pairs to do machine learning

With no access to cover images, Machine Learning is not possible

Payload, password

Original image

Image processing-unknown

Cover image

Internal to app - inaccessible to user

Developer embedding algorithm

Stego image

Machine Learning

Feature extraction

Training & Validation

Classifier

Reverse Engineer Android Stego Apps

- Reverse engineering process*
  1. Identify important GUI widgets
  2. Locate corresponding callback methods
  3. Analyze binary code with control flow graphs

- Tools used:
  - APKTool, Smali

*Forensic analysis of android steganography apps," In G. Peterson and S. Shenoi, eds., Advances in Digital Forensics XIV, Cham. Springer Int'l. Publishing, pp. 293-312, 2018.


```
<node resource-
id="id/action"
text="Hide It"/>
```

```
id/action = 0x7f050003
```

```
findViewById(0x7f050003)
.setOnClickListener(…);
```

```
public void onClick(View v)
{
    ....
}
```

Modified app code allows generation of desired data*

- Once we reversed-engineered the app, we can obtain any information and data inside the app
  - Obtain **Covers**
  - **Identify image processing**
  - **Determine the precise embedding algorithm** the developer implemented
  - **Implement specific embedding rates of own choosing**
  - Create Machine Learning algorithms needing pairs of cover-stego images
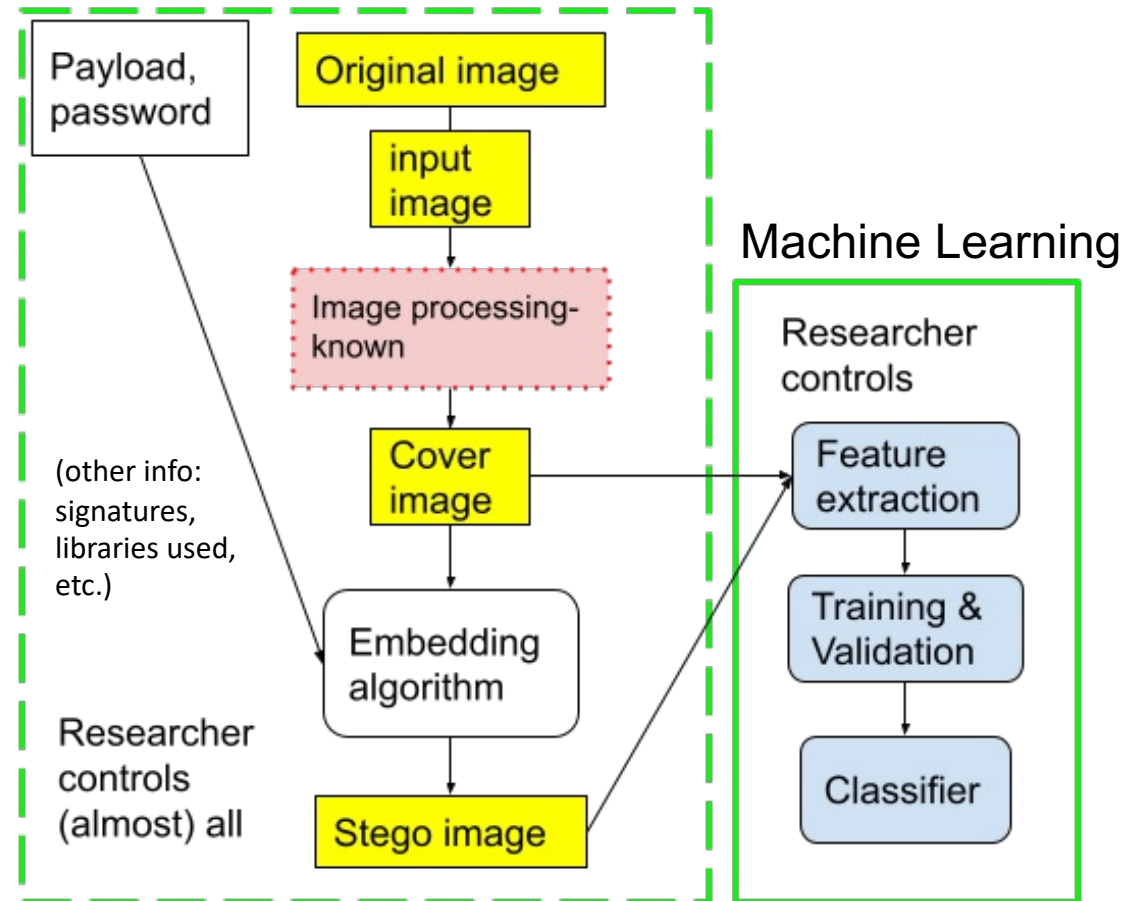
*W. Chen, L. Lin, M. Wu, Y. Guan, and J. Newman. "Tackling Android Stego Apps in the Wild," 2018 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC), Honolulu, HI, pp. 1564-1573, 2018.

What Data is in StegoAppDB?

- The four images as used by developers in their code
  - **Original image**
  - **Input image**
  - **Cover image**
  - **Stego image** (6 different mobile stego apps, 5 embedding rates)

- 20 images for one scene acquisition
  - 2 format types: high-quality jpeg, and DNG
  - 10 different exposure settings
  - Acquired using our camera app *Cameraw*

- Data associated with each image
  - Acquisition parameters – EXIF
  - Image association between original, input, cover and stego versions
  - Embedding text (The Complete Works of William Shakespeare)
  - Small-sized images (512 x 512 center crop)

Example of image types from StegoAppDB

Original image

Dimensions	4032 X 3024
Size	2.1 MB
Camera	Pixel2-1
Format	JPEG
Colorspace	RGB
JPEG Qual	90
ISO	500
Exposure time (s)	1/60

Input image

Dimensions	512 X 512
Size	188 KB
Format	PNG
Colorspace	Gray
Processing	Cropped
Processing	JPG -> Gray PNG

Cover image

Dimensions	512 X 512
Size	336 KB
Format	PNG
Colorspace	RGB/Gray
Processing	Known

Stego image

Dimensions	512 X 512
Size	337 KB
Format	PNG
Colorspace	RGB/Gray
Processing	Message embedded
Steg app	MobiStego
Emb. Rate	5 %

Stego image

Dimensions	512 X 512
Size	389 KB
Format	PNG
Colorspace	RGB/Gray
Processing	Message embedded
Steg app	MobiStego
Emb. Rate	10 %

Count of images in StegoAppDB: 724,460 images

Device Model	# Devices	ISO Range	Exposure Time Range	# Scenes	# Original Images	# Cropped Images	# Covers	# Stegos
Google Pixel 1	4	$107 \sim 3735$	$1/120 \sim 1/12$	284	5680	5680	25560	127800
Google Pixel 2	4	$86 \sim 2927$	$1/249 \sim 1/12$	286	5720	5720	25740	128700
Samsung Galaxy S8	2	$57 \sim 6846$	$1/120 \sim 1/12$	173	3460	3460	15570	77850
OnePlus 5	2	$100 \sim 3000$	$1/9846 \sim 1/15$	156	3120	3120	14040	70200
iPhone 6s	4	$40 \sim 1600$	$1/60 \sim 1/3$	284	5680	5680	5680	28400
iPhone 6s Plus	2	$25 \sim 1250$	$1/66 \sim 1/3$	181	3620	3620	3620	18100
iPhone 7	4	$25 \sim 1000$	$1/60 \sim 1/3$	285	5700	5700	5700	28500
iPhone 7 Plus	2	$25 \sim 1000$	$1/80 \sim 1/3$	185	3700	3700	3700	18500
iPhone 8	2	$32 \sim 1250$	$1/60 \sim 1/3$	142	2840	2840	2840	14200
iPhone X	2	$20 \sim 1600$	$1/62 \sim 1/3$	192	3840	3840	3840	19200
Total	28	$20 \sim 6846$	$1/9846 \sim 1/3$	2168	43360	43360	106290	531450
Total Images								724460

StegoAppDB webpages

https://forensicstats.org/stegoappdb/

Download files
csv files (≤ 3), folder structure, & readme

CSV File: original image information

StegoAppDB_stegos_20201029-172106_original_directory

original_image_id	original_image_filename	image_type	image_bytes	image_source_device	device_model	image_format	jpg_quality	make	camera_model_name	exposure_time	f_number	iso	focal_length	exposure_mode	white_balance	image_width	image_height	device_index	scene_label
611381	611381.JPG	original	2803793	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	604.0	4.4 mm	Auto	Auto	4032	3024	1	
611961	611961.JPG	original	2750633	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	536.0	4.4 mm	Auto	Auto	4032	3024	1	
615441	615441.JPG	original	3058133	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/30	1.8	844.0	4.4 mm	Auto	Auto	4032	3024	1	
616021	616021.JPG	original	2697701	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	624.0	4.4 mm	Auto	Auto	4032	3024	1	
616601	616601.JPG	original	2547881	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	512.0	4.4 mm	Auto	Auto	4032	3024	1	
617181	617181.JPG	original	2331672	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	628.0	4.4 mm	Auto	Auto	4032	3024	1	
618921	618921.JPG	original	2971292	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	616.0	4.4 mm	Auto	Auto	4032	3024	1	
619501	619501.JPG	original	2930355	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/30	1.8	896.0	4.4 mm	Auto	Auto	4032	3024	1	
620081	620081.JPG	original	3143739	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	520.0	4.4 mm	Auto	Auto	4032	3024	1	
622981	622981.JPG	original	3003488	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/30	1.8	728.0	4.4 mm	Auto	Auto	4032	3024	1	
624721	624721.JPG	original	3120012	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	820.0	4.4 mm	Auto	Auto	4032	3024	1	
627041	627041.JPG	original	2449145	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/120	1.8	552.0	4.4 mm	Auto	Auto	4032	3024	1	
629361	629361.JPG	original	2505865	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	636.0	4.4 mm	Auto	Auto	4032	3024	1	
629941	629941.JPG	original	2843700	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	680.0	4.4 mm	Auto	Auto	4032	3024	1	
631101	631101.JPG	original	2520249	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	764.0	4.4 mm	Auto	Auto	4032	3024	1	
632261	632261.JPG	original	2364639	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	592.0	4.4 mm	Auto	Auto	4032	3024	1	
632841	632841.JPG	original	2574457	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	504.0	4.4 mm	Auto	Auto	4032	3024	1	
633421	633421.JPG	original	2344791	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	548.0	4.4 mm	Auto	Auto	4032	3024	1	
634001	634001.JPG	original	2543152	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	552.0	4.4 mm	Auto	Auto	4032	3024	1	
634581	634581.JPG	original	2370022	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	500.0	4.4 mm	Auto	Auto	4032	3024	1	
636901	636901.JPG	original	2369295	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/60	1.8	568.0	4.4 mm	Auto	Auto	4032	3024	1	
642121	642121.JPG	original	3790868	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	544.0	4.4 mm	Auto	Auto	4032	3024	1	
644441	644441.JPG	original	3567800	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	944.0	4.4 mm	Auto	Auto	4032	3024	1	
646181	646181.JPG	original	2944128	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	836.0	4.4 mm	Auto	Auto	4032	3024	1	
646761	646761.JPG	original	2584564	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/40	1.8	944.0	4.4 mm	Auto	Auto	4032	3024	1	
647921	647921.JPG	original	2100108	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/24	1.8	1020.0	4.4 mm	Auto	Auto	4032	3024	1	
648591	648591.JPG	original	2449749	Pixel2-1	Pixel2	JPG	90	Google	Pixel 2	1/24	1.8	856.0	4.4 mm	Auto	Auto	4032	3024	1	

CSV File: input & cover image info

StegoAppDB_stegos_20201029-172106_input_directory

input_image_id	input_image_filename	image_type	original_image_id	input_image_bytes
611382	611382.PNG	input	611381	122542
611962	611962.PNG	input	611961	135185
615442	615442.PNG	input		
616022	616022.PNG	input		
616602	616602.PNG	input		
617182	617182.PNG	input		
618922	618922.PNG	input		
619502	619502.PNG	input		
620082	620082.PNG	input		
622982	622982.PNG	input		
624722	624722.PNG	input		
627042	627042.PNG	input		
629362	629362.PNG	input		

StegoAppDB_stegos_20201029-172106_cover_directory

cover_image_id	cover_image_filename	image_type	input_image_id	cover_image_bytes
611407	611407.PNG	cover	611382	197864
611987	611987.PNG	cover	611962	220071
615467	615467.PNG	cover	615442	213230
616047	616047.PNG	cover	616022	256997
616627	616627.PNG	cover	616602	219667
617207	617207.PNG	cover	617182	197194
618947	618947.PNG	cover	618922	223766
619527	619527.PNG	cover	619502	207928
620107	620107.PNG	cover	620082	217055
623007	623007.PNG	cover	622982	204369
624747	624747.PNG	cover	624722	245149
627067	627067.PNG	cover	627042	191813
629387	629387.PNG	cover	629362	241086

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CSV File: stego image information

- Heavily provenanced

- Name of original image used in creation path to stego image

- Mobile app used; message content; embedding rate; etc.

StegoAppDB_stegos_20201029-172106_stego_directory

image_id	image_filename	image_type	image_bytes	cover_image_id	cover_image_filename	input_image_id	input_image_filename	original_image_id	original_image_filename	exposure_mode	exposure_time	iso	image_source_device	embedding_method	embedding_rate	message_length	message_dictionary	message_starting_index	passwo
611408	611408.PNG	stego	213528	611407	611407.PNG	611382	611382.PNG	611381	611381.JPG	Auto	1/60	604.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_henryv.txt	2938	N/A
611409	611409.PNG	stego	225209	611407	611407.PNG	611382	611382.PNG	611381	611381.JPG	Auto	1/60	604.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_cleopatra.txt	953	N/A
611988	611988.PNG	stego	233417	611987	611987.PNG	611962	611962.PNG	611961	611961.JPG	Auto	1/40	536.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_pericles.txt	833	N/A
611989	611989.PNG	stego	245577	611987	611987.PNG	611962	611962.PNG	611961	611961.JPG	Auto	1/40	536.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_othello.txt	1992	N/A
615468	615468.PNG	stego	227111	615467	615467.PNG	615442	615442.PNG	615441	615441.JPG	Auto	1/30	844.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_cymbeline.txt	2016	N/A
615469	615469.PNG	stego	238224	615467	615467.PNG	615442	615442.PNG	615441	615441.JPG	Auto	1/30	844.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_henryviii.txt	1924	N/A
616048	616048.PNG	stego	284309	616047	616047.PNG	616022	616022.PNG	616021	616021.JPG	Auto	1/40	624.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_comedy_errors.txt	354	N/A
616049	616049.PNG	stego	297822	616047	616047.PNG	616022	616022.PNG	616021	616021.JPG	Auto	1/40	624.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_comedy_errors.txt	1076	N/A
616628	616628.PNG	stego	242327	616627	616627.PNG	616602	616602.PNG	616601	616601.JPG	Auto	1/40	512.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_hamlet.txt	2086	N/A
616629	616629.PNG	stego	253974	616627	616627.PNG	616602	616602.PNG	616601	616601.JPG	Auto	1/40	512.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_tempest.txt	1155	N/A
617208	617208.PNG	stego	214804	617207	617207.PNG	617182	617182.PNG	617181	617181.JPG	Auto	1/60	628.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_richardiii.txt	832	N/A
617209	617209.PNG	stego	226413	617207	617207.PNG	617182	617182.PNG	617181	617181.JPG	Auto	1/60	628.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_othello.txt	4035	N/A
618948	618948.PNG	stego	240730	618947	618947.PNG	618922	618922.PNG	618921	618921.JPG	Auto	1/60	616.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_henryvi.txt	10723	N/A
618949	618949.PNG	stego	251936	618947	618947.PNG	618922	618922.PNG	618921	618921.JPG	Auto	1/60	616.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_taming_shrew.txt	2131	N/A
619528	619528.PNG	stego	224356	619527	619527.PNG	619502	619502.PNG	619501	619501.JPG	Auto	1/30	896.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_lll.txt	2009	N/A
619529	619529.PNG	stego	235400	619527	619527.PNG	619502	619502.PNG	619501	619501.JPG	Auto	1/30	896.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_merchant.txt	313	N/A
620108	620108.PNG	stego	232952	620107	620107.PNG	620082	620082.PNG	620081	620081.JPG	Auto	1/60	520.0	Pixel2-1	MobiStego	0.049997967	9824	shakespeare_henryv.txt	2502	N/A
620109	620109.PNG	stego	244486	620107	620107.PNG	620082	620082.PNG	620081	620081.JPG	Auto	1/60	520.0	Pixel2-1	MobiStego	0.09999593	19654	shakespeare_lll.txt	1389	N/A

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Questions?

Thank you!