Detection and Tracking of Forged Digital Images from Social Media

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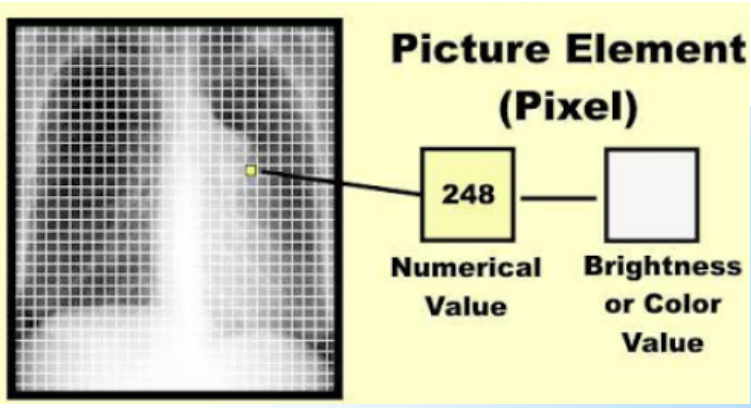
Road Map

- Overview of Digital Image
- Fake Images in Social Media
- Detection and Tracking
- Clone Detection using Forensically
- Detection and Tracking
- JPEGSnoop for Image Tracking
- Challenges and Limitations

*Overview of Digital Image

- Digital image is composed of picture elements, known as **pixels**, each with a finite set of numeric representation, that can be handled and stored by a digital computer.
- The digital image consists of a fixed number of rows and columns of pixels.
- Web browsers can display standard internet image formats such as **JPEG**, **GIF** and **PNG**.



*Fake Images in Social Media

- Images can be cloned or forged using image processing applications.
- Regions in the image can be manipulated by playing with colors or copying objects from other images.
- The fake images cannot be detected with the naked eye.
- Social Media strips-off metadata from uploaded images, which makes tracking of the image difficult.

✗ FAKE

✗ Terror-linked social media accounts shared a photo of a mother and her child who died in the rubble, supposedly during Turkey's anti-terror operation in northern Syria

✓ REAL

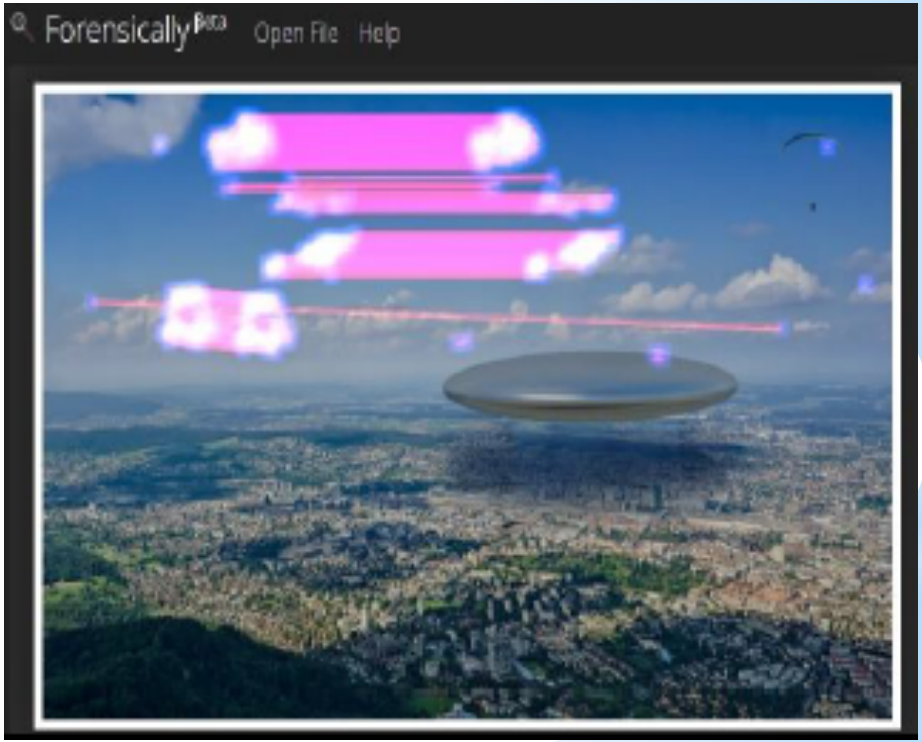
✓ The image was actually taken in another part of Syria in 2016

*Detection and Tracking

- The real difficulty in the investigation is to detect the cloned regions and track the source of the image.
- Tracking the image source is a challenge in the absence of EXIF Metadata.
- Open-source tools **Forensically** and **JPEGSnoop** prove to be useful to a great extent.
- These tools analyze and detect cloned regions in the image.

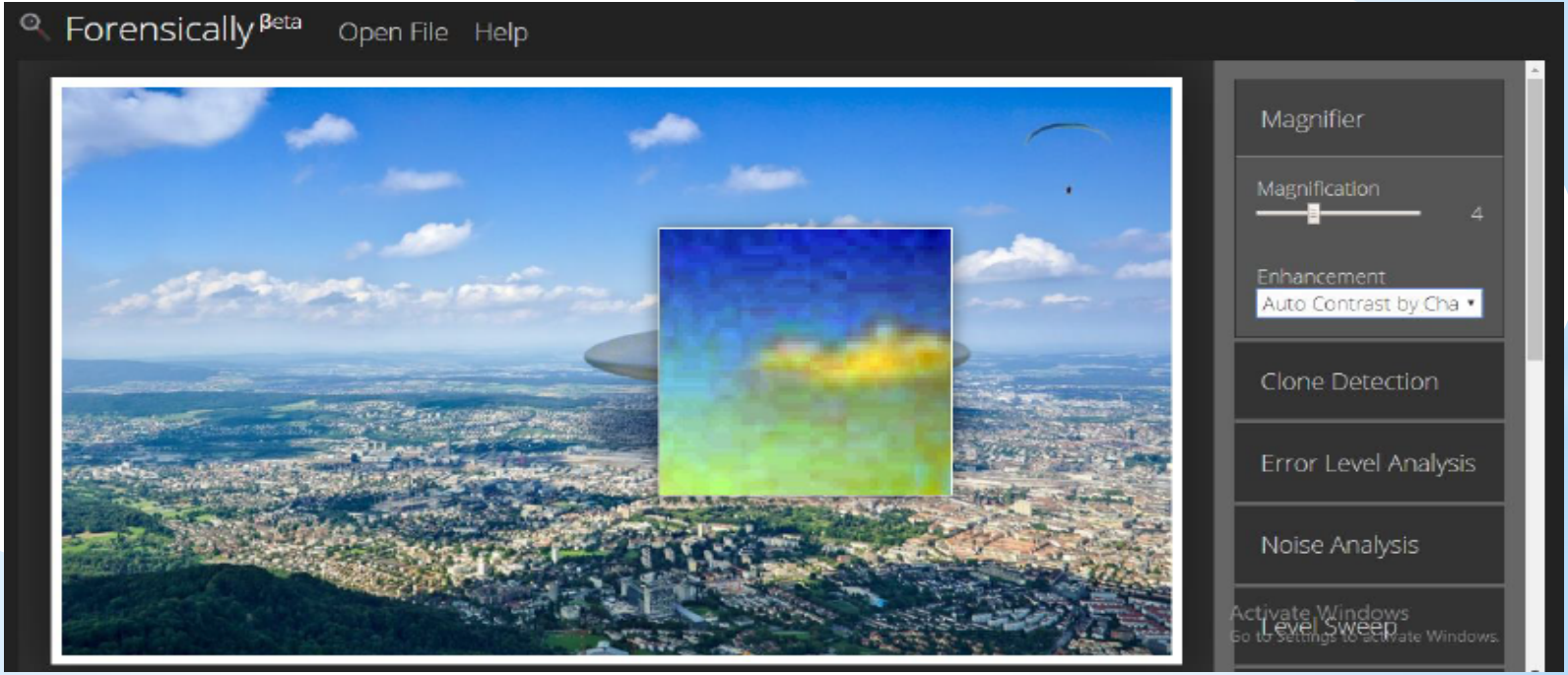
*Clone Detection using Forensically

- Magnification
- Cloned Detection
- Error-level Analysis
- Noise Analysis
- JPEG Analysis
- Structural and String Analysis



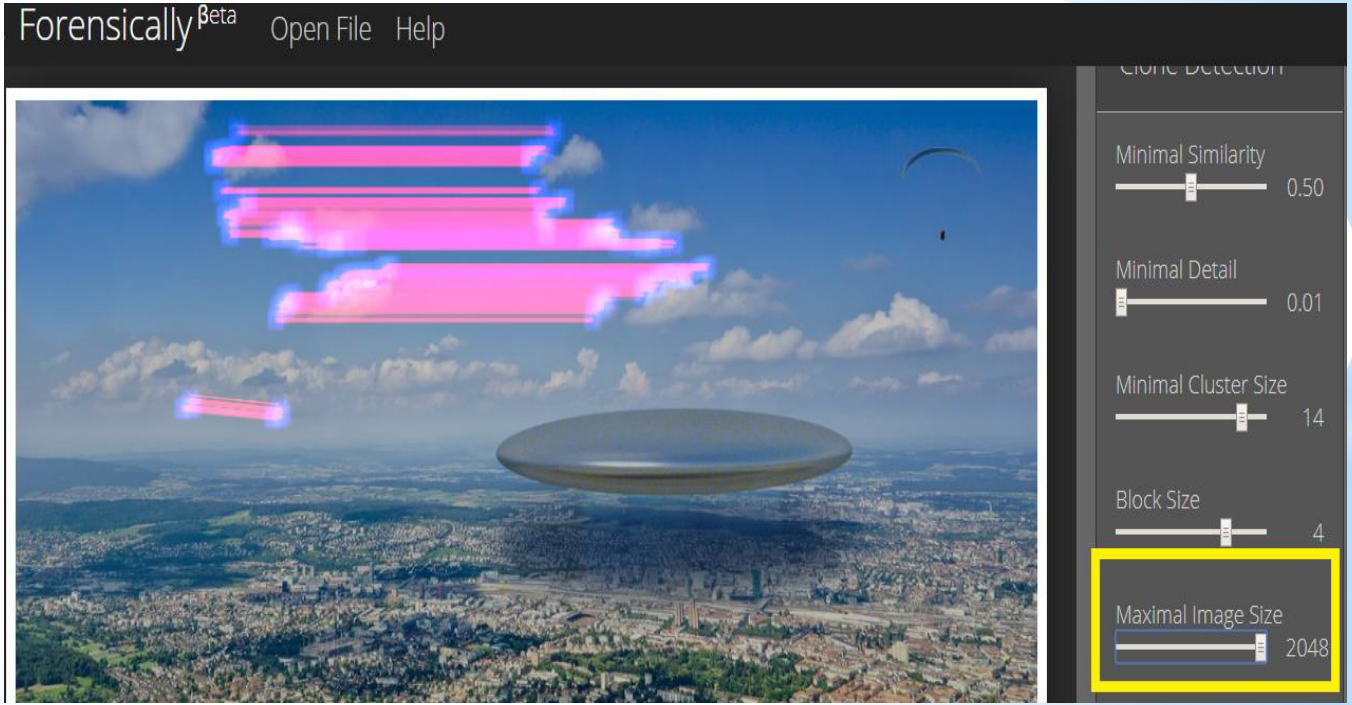
Detection and Tracking- Magnifier

- Controlling the zoom level
- **Auto-contrast** and **Auto-contrast by Channel**.



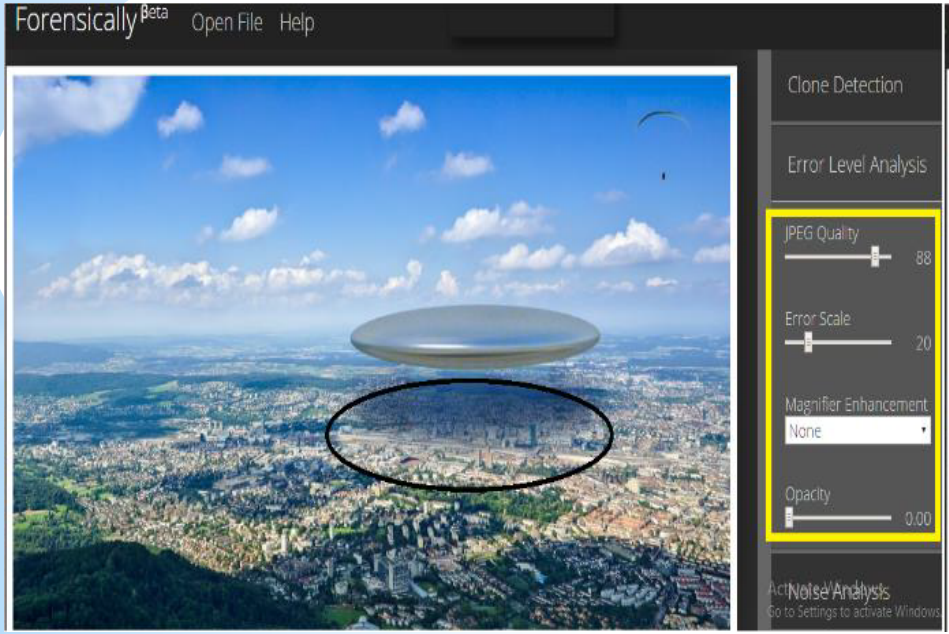
* Detection and Tracking- Cloned Detection

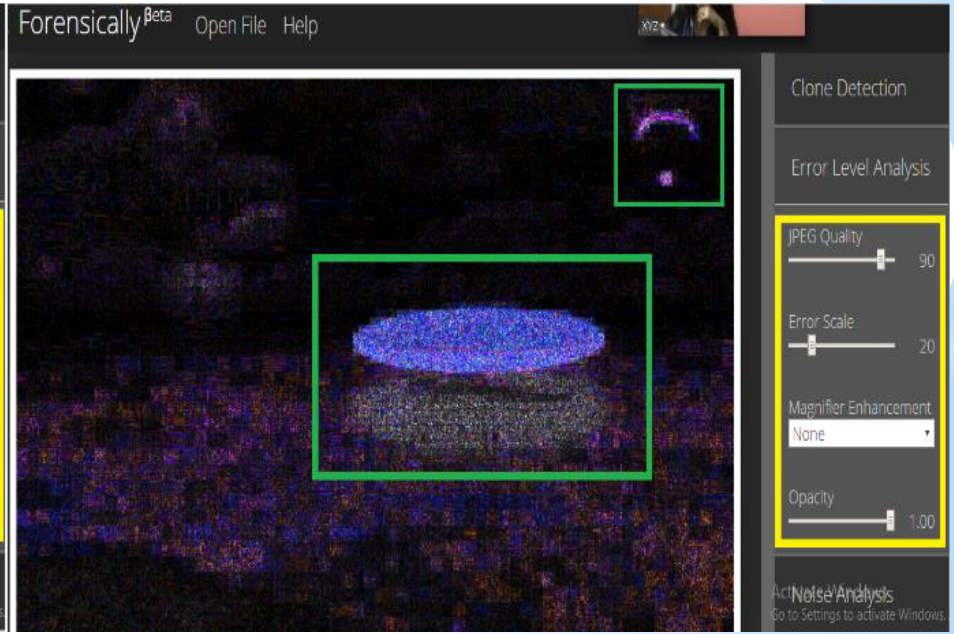
- Minimal similarity.
- Minimal details.
- Minimal cluster size.
- Block size
- Maximal Image size



* Detection and Tracking- Error Level Analysis

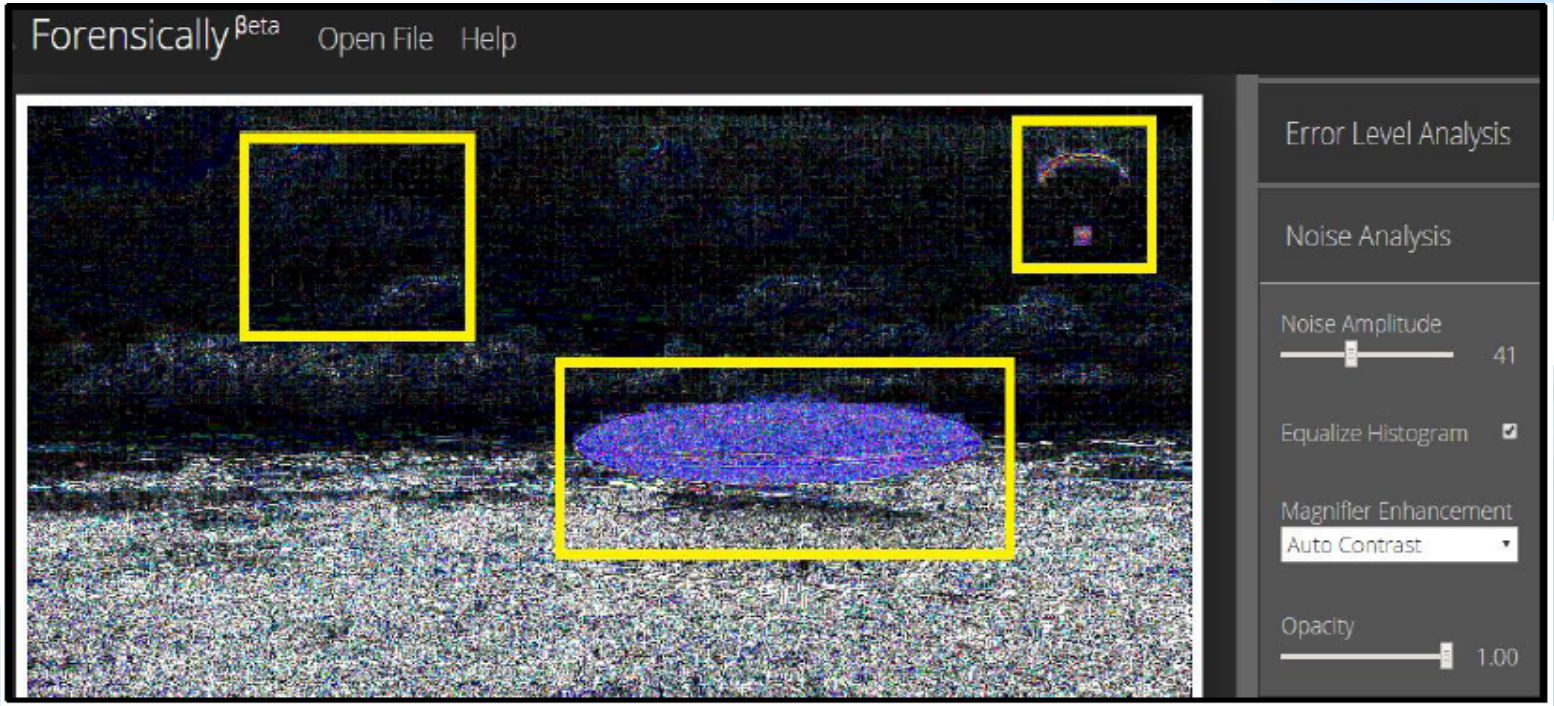
- It is used to spot the artifacts that have been implanted on an image by compressing it multiple times.
- The parameters used are: **JPEG Quality**, **Opacity** and **Error Scale**





* Detection and Tracking- Noise Analysis

- It is used to identify unwanted noise in the image.
- The parameters used are: **Noise Amplitude** and **Opacity**.



* Detection and Tracking- JPEG Analysis

- It contains 8x8 tables, called **Quantization tables**, which specify the way an image has been compressed.
- Each cell in the table represents pixels intensities ranging from **0 to 255**.
- In order to compress the image, the pixel intensities are modified by the software application in the range of **-128 to 127**, and new quantization table is calculated.
- The value of the standard quantization table is **95**, which is automatically created when image is not processed.
- Adobe Photoshop uses quantization table of the value **85** (Photoshop Quality).

* Detection and Tracking- JPEG Analysis

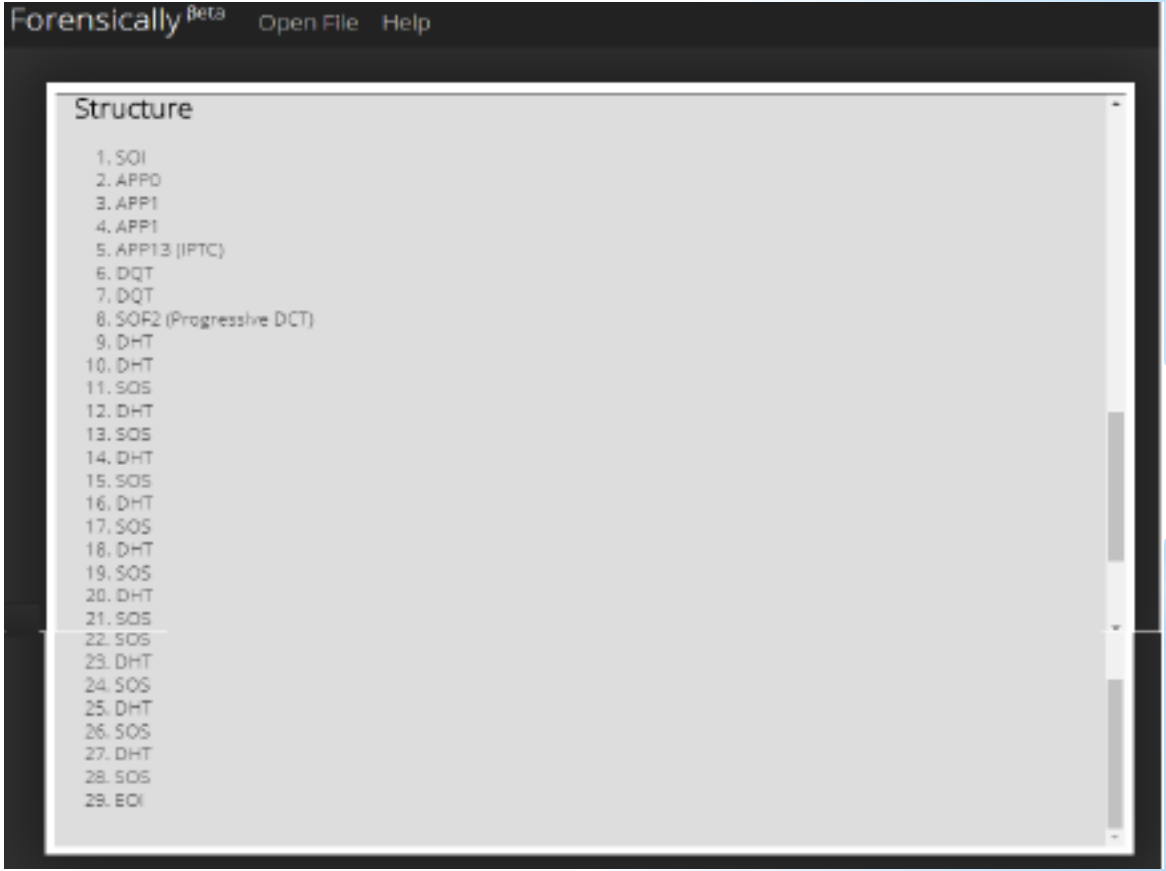
JPEG images also contains "**Comment**" section, which might contain useful information such as source of the image file, or any software application used for writing the image etc.

* Detection and Tracking- Structural Analysis

- Structural Analysis of a JPEG image refers to the analysis of the order of different sections (markers) of the image.
- The markers **SOI (Start of Image)** and **EOI (End of Image)**, indicate the beginning and start of the image file.
- Multiple SOI and EOI markers indicate presence of hidden image.
- Application Segment markers include: **APP0**, **APP1** and **APP13**.
- APP0 contains the **JPEG version**, **screen** and **printing resolution**.
- APP1 contains information on imaging parameters like **date/time**, **focal length**, **aperture** etc.
- APP13 indicates that **image has been processed** using Adobe Photoshop.

* Detection and Tracking- Structural Analysis

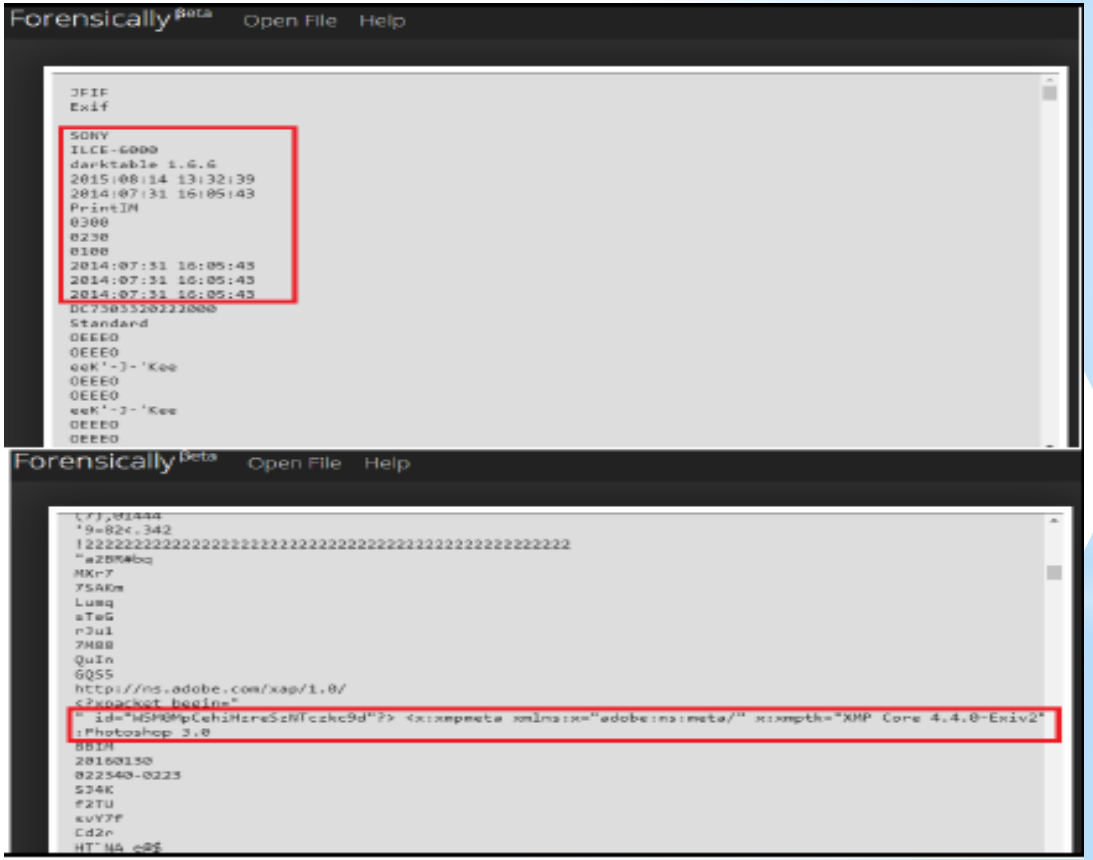
Presence of marker **SOS (Start-of-Scan)** will indicate that the image has been compressed.



* Detection and Tracking- String Analysis

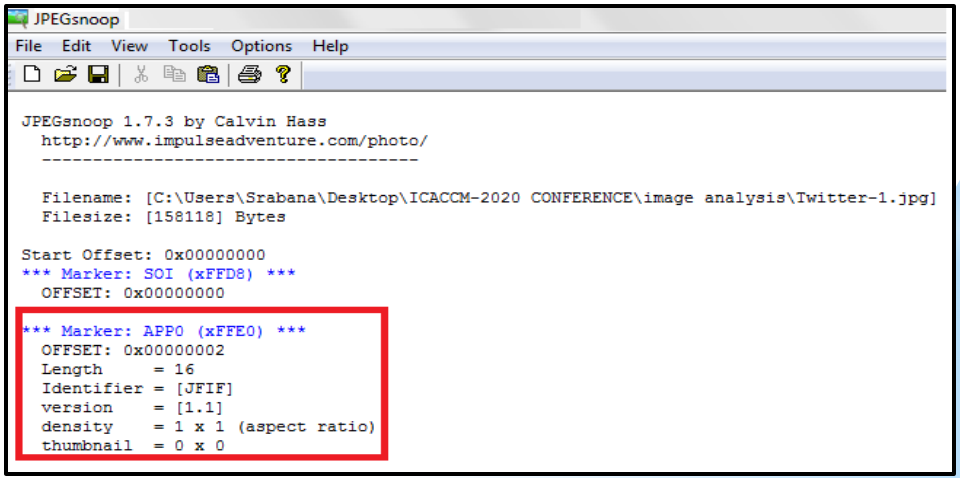
Strings are the pieces of data contained in the JPEG image, which can provide much useful information in the absence of EXIF metadata.

While analyzing images from Facebook, a string of the order of "**FBMD01000a9...**", indicates that the image might have been uploaded using a web interface



* JPEGSnoop for Image Tracking

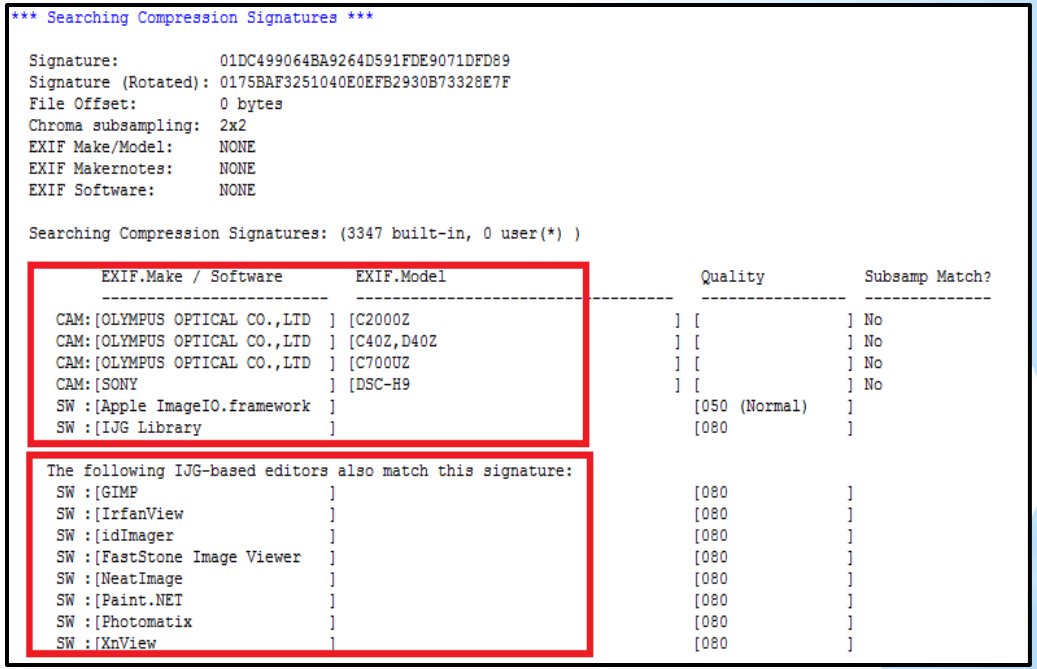
- JPEGSnoop is a JPEG image examination tool, which is used for extracting embedded information from JPEG images.
- It is used to identify "**Original Transmission Reference**", which refers to a number or an identifier embedded in the image, provided by the creator or image provider and is used for transmission and tracking purposes.



* JPEGSnoop for Image Tracking

Based on the **compression signature** of the cloned image, it generates a list of devices/software, which could have been possibly used for taking the image or creating the image.

This information can be used for tracking which device and model might have been used to click the picture, especially when the EXIF metadata from the image file is missing.



```
*** Searching Compression Signatures ***

Signature:           01DC499064BA9264D591FDE9071DFD89
Signature (Rotated): 0175BAF3251040E0EFB2930B73328E7F
File Offset:         0 bytes
Chroma subsampling:  2x2
EXIF Make/Model:     NONE
EXIF Makernotes:     NONE
EXIF Software:       NONE

Searching Compression Signatures: (3347 built-in, 0 user(*) )

        EXIF.Make / Software        EXIF.Model                          Quality          Subsamp Match?
        ------------------------    --------------------------------    ---------------  --------------
  CAM:[OLYMPUS OPTICAL CO.,LTD  ] [C2000Z                          ] [               ] No
  CAM:[OLYMPUS OPTICAL CO.,LTD  ] [C40Z,D40Z                       ] [               ] No
  CAM:[OLYMPUS OPTICAL CO.,LTD  ] [C700UZ                          ] [               ] No
  CAM:[SONY                     ] [DSC-H9                          ] [               ] No
  SW :[Apple ImageIO.framework  ]                                    [050 (Normal)    ]
  SW :[IJG Library              ]                                    [080             ]

The following IJG-based editors also match this signature:
  SW :[GIMP                     ]                                    [080             ]
  SW :[IrfanView                ]                                    [080             ]
  SW :[idImager                 ]                                    [080             ]
  SW :[FastStone Image Viewer   ]                                    [080             ]
  SW :[NeatImage                ]                                    [080             ]
  SW :[Paint.NET                ]                                    [080             ]
  SW :[Photomatix               ]                                    [080             ]
  SW :[XnView                   ]                                    [080             ]
```

* Challenges and Limitations

- Magnification using “Auto-Contrast by Channel” splatters the colors of the image.
- GPS data might not be available if image is clicked using smartphone with GPS disabled.
- Social media platforms strip-off the metadata, which makes tracking difficult. Structural, JPEG and string analysis may be done.
- JPEG Analysis can identify quantization tables only if image is processed and edited using Adobe Photoshop.

Thank You and Questions!

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