Fast Camera Fingerprint Matching In Very Large Databases

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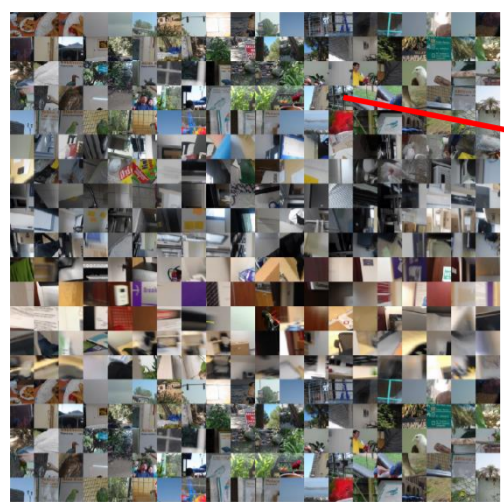
MOTIVATION AND OBJECTIVE

- PRNU based source camera attribution is a technique to determine the origin of images. However, querying a camera fingerprint is a computationally expensive task when the database is very large (i.e. millions of cameras). Efficient algorithms are required to make this task feasible

Social Media

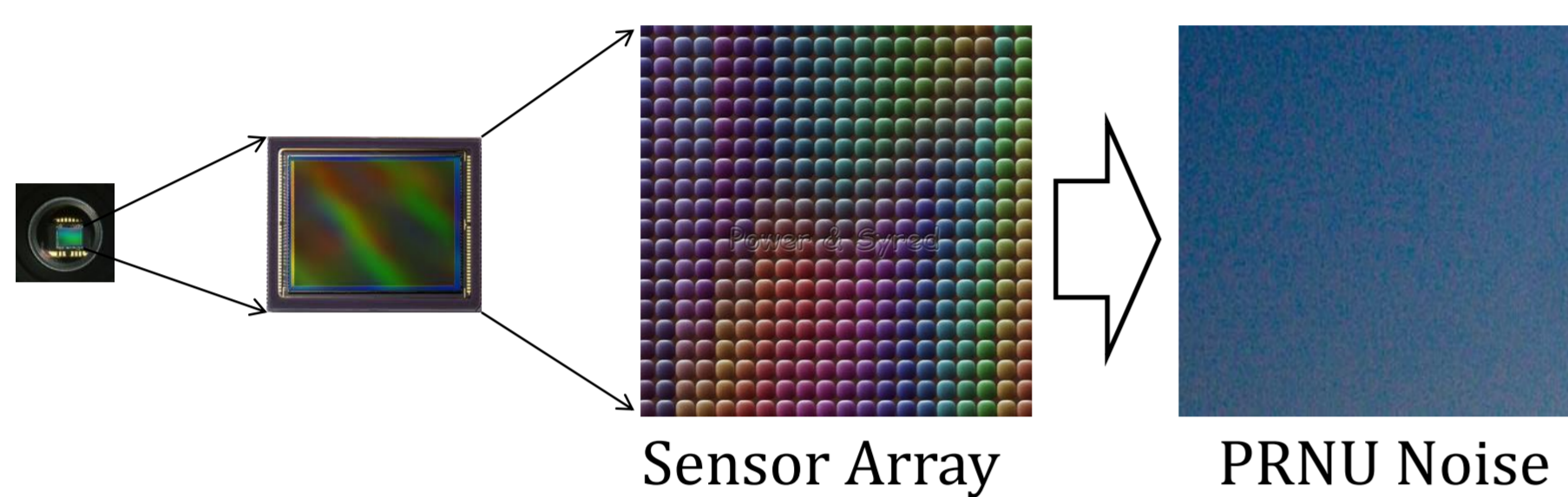Anonymous Image

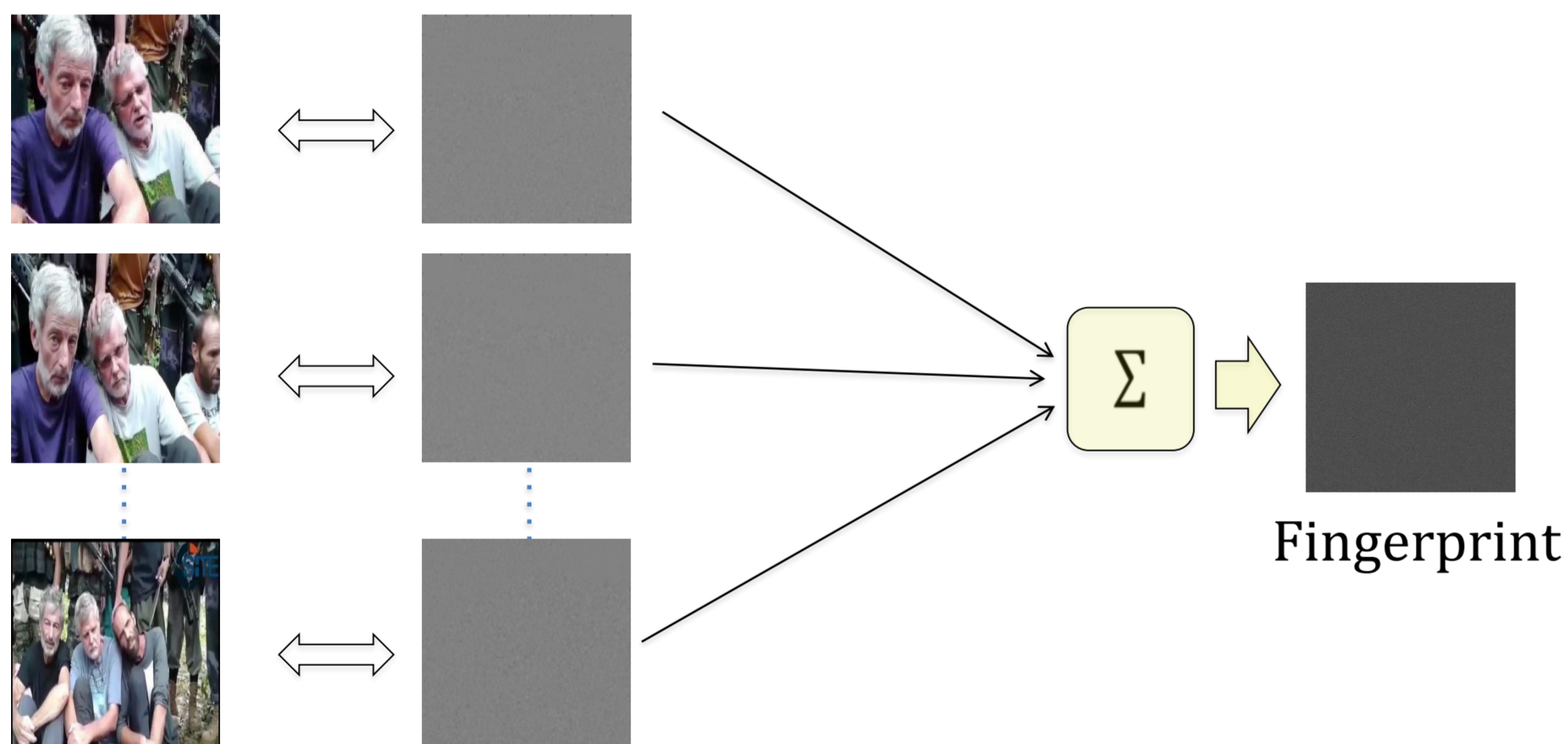Motivation: Who captured the image?

Anonymous Image

Objective: How to determine origin camera efficiently?
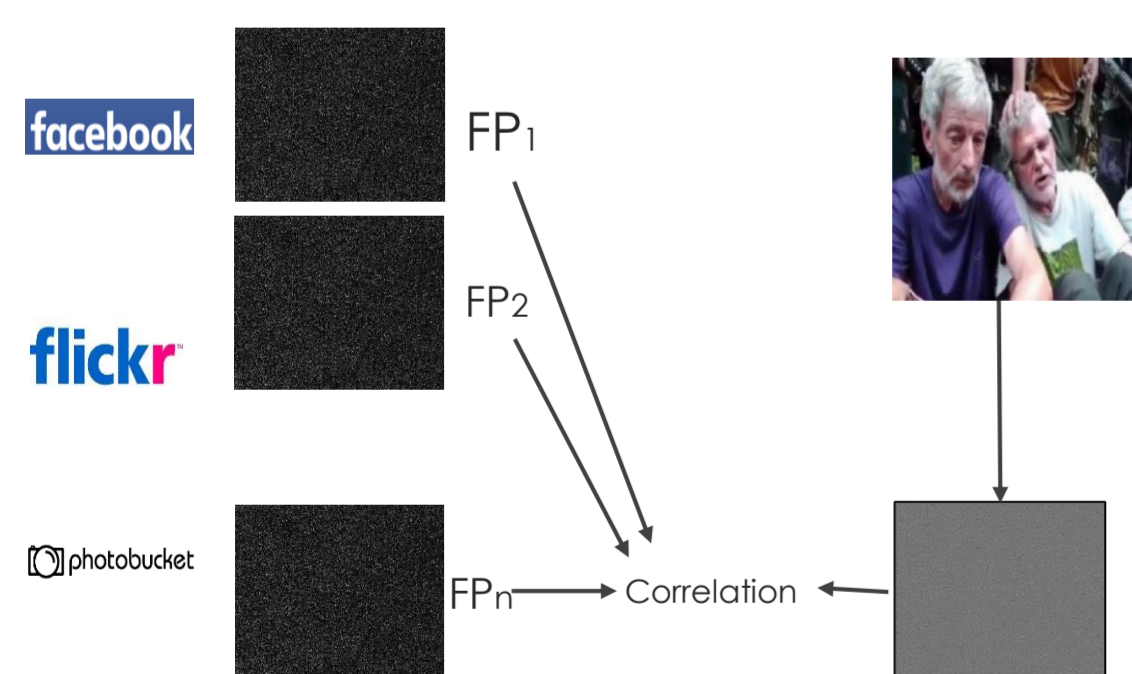
APPROACH: PRNU BASED METHOD

- Every camera has a unique PRNU (Photo Response Non Uniformity) noise that can act as fingerprint.

Sensor Array   PRNU Noise

- Finding exact PRNU difficult. Fingerprint can be found from a set from estimated PRNU of a set of video frames.

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Fingerprint

IDENTIFICATION CHALLANGES

facebook FP_1

flickr FP_2

photobucket FP_n → Correlation
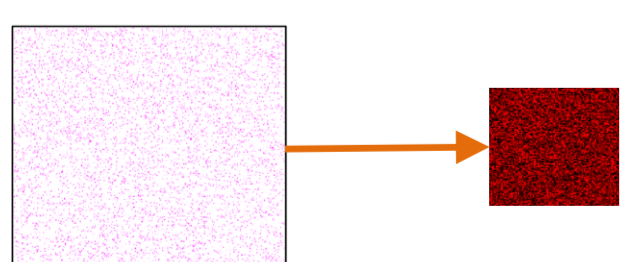
- Search: Linear search takes 1000+ seconds when 16K fingerprint exist.
- Storage: Each fingerprint is 4 MB for 1 MP image.
- Due to random nature of fingerprint, it cannot be compressed.
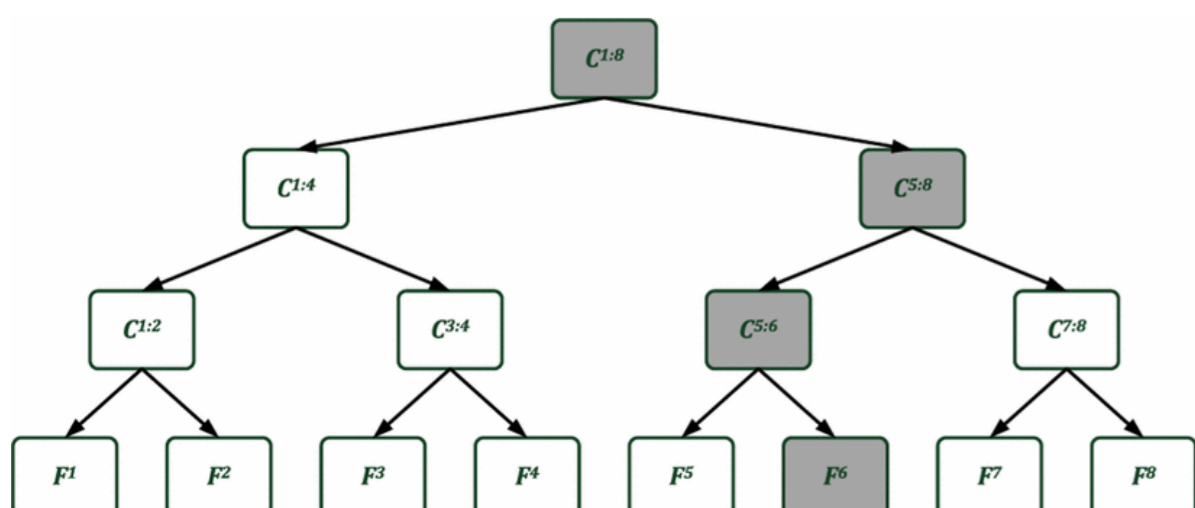
PREVIOUS WORK

- Linear Search Over Fingerprint Digests

- Subset of pixels
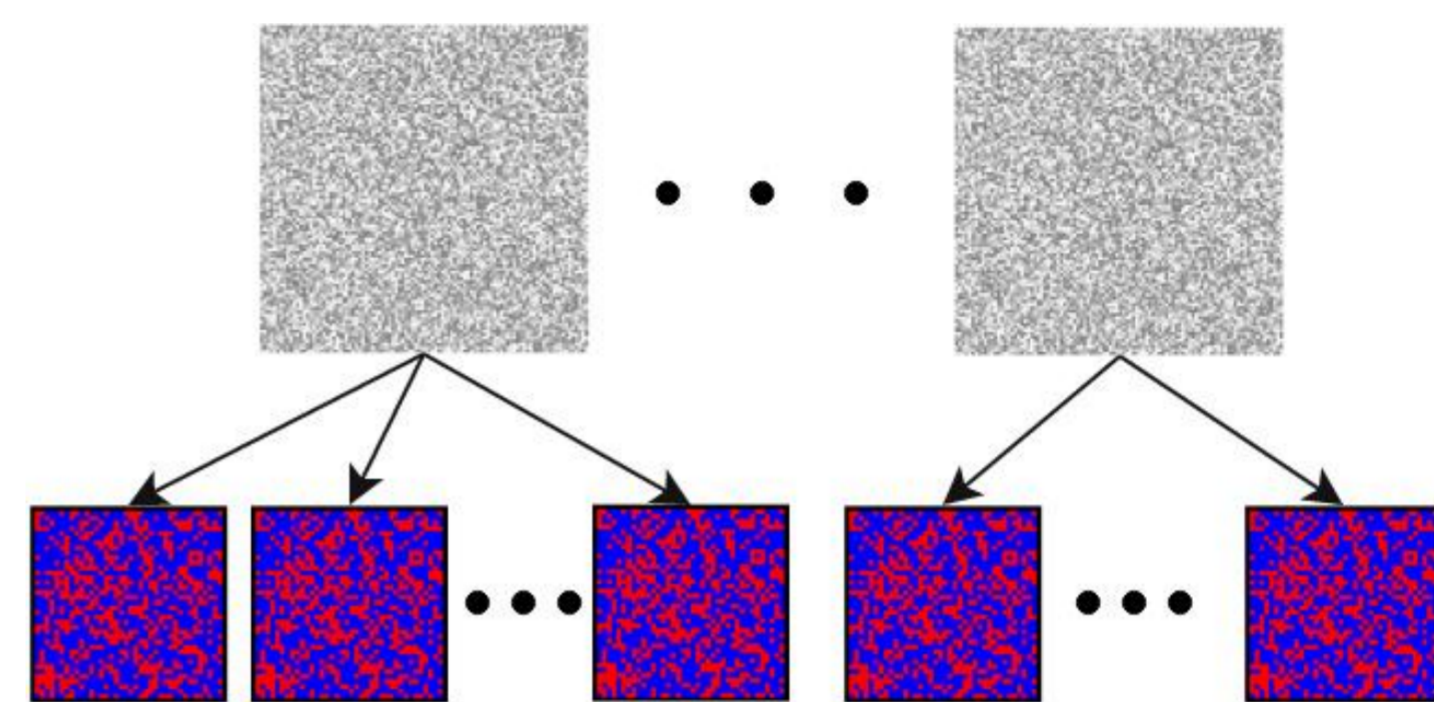- Faster pairwise correlation

- Composite Based Search
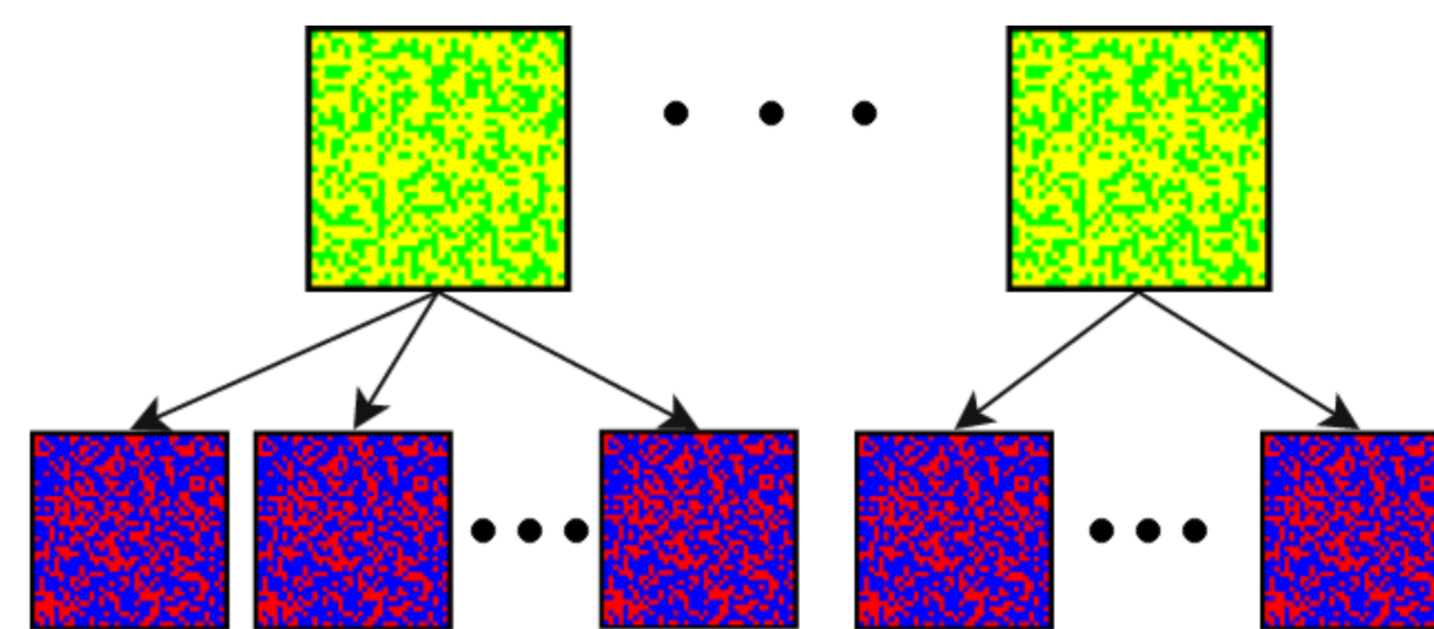

- Fewer number of correlations

OUR SOLUTION

Approach 1

- 2-level hybrid tree
- Root is a composite fingerprint
- Leaves are fingerprint digest

Approach 2

- Root node (composite) is also a fingerprint digest

EXPERIMENTS

- 176K images, 11 trees of 16K
- 3 known cameras, 18 random cameras
- H_0, H_1^1, H_1^5
- Composite Size: 64, 128, 256, 512, 1024, 2048, 4096
- Composite Digest Length: 16K, 20K, 36K, 64K
- Fingerprint Digest Length: 14K pixels

RESULTS

Querying single camera fingerprint in 16K noise set

- Linear Search   : 1163 sec
- Fingerprint Digest : 22.1 sec
- Composite Search   : 18.8 - 46.9 sec
- Approach 1   : 11.2 - 16.3 sec
- Approach 2   : 3.5 – 10.6 sec

- **Approach 2 achieves around 3-7 times speed up compared to previous work**