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ENFSI – DIWG

14th Meeting

2-5 Sept. 2014, Bucharest

From the academic research...



UNIVERSITÀ
DEGLI STUDI
FIRENZE

- Dept. Information Engineering of the University of Florence, Italy
 - Information and Communication Technology



consorzio nazionale
interuniversitario
per le telecomunicazioni

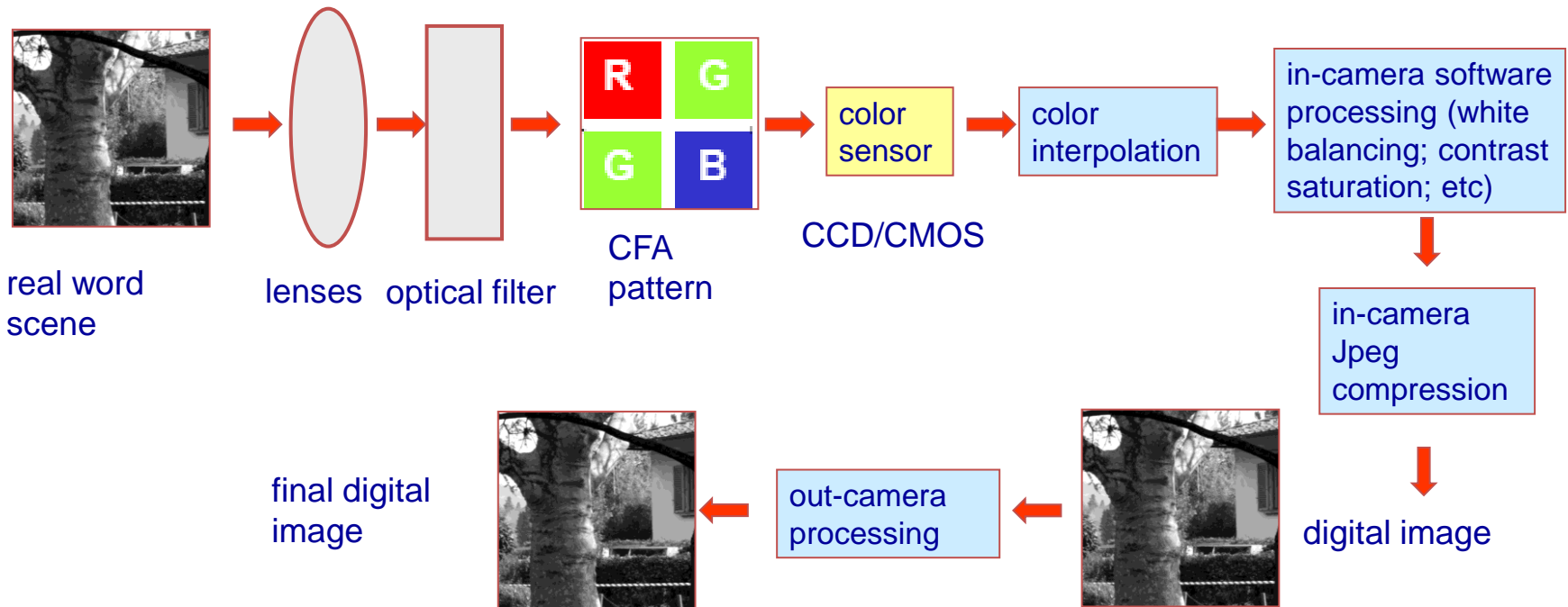
- CNIT – National Inter-University Consortium for Telecommunications (Italy)

Research area: Multimedia Forensics

- Any acquisition and processing step leaves on the multimedia content (audio tracks, images, video sequences) some traces, detectable although imperceptible.
- These digital traces (as digital footprints or digital fingerprints) can be extracted from the audio-visual object for acquiring important information on its history.

Research area: Multimedia Forensics

- E.g., digital Image life cycle



- Possible digital traces: sensor noise, interpolation, compression, non linear operation, splicing, cloning, illumination, ...

Research area: Multimedia Forensics

- Possible recovered information:
 - check if an image has been changed, even in small part (photomontage)
 - detect the insertion, removal or alteration of frames in digital video
 - study the integrity of audio recordings
 - distinguish if the content is real or computer generated
 - distinguish between different devices (camera, scanner, smartphone, ...)
 - distinguish which camera captured the image
 - analyze the content of images and video sequences

European Projects

- The academic research activity is carried out also in the framework of EU-funded Projects





<http://www.maven-project.eu/index.html>

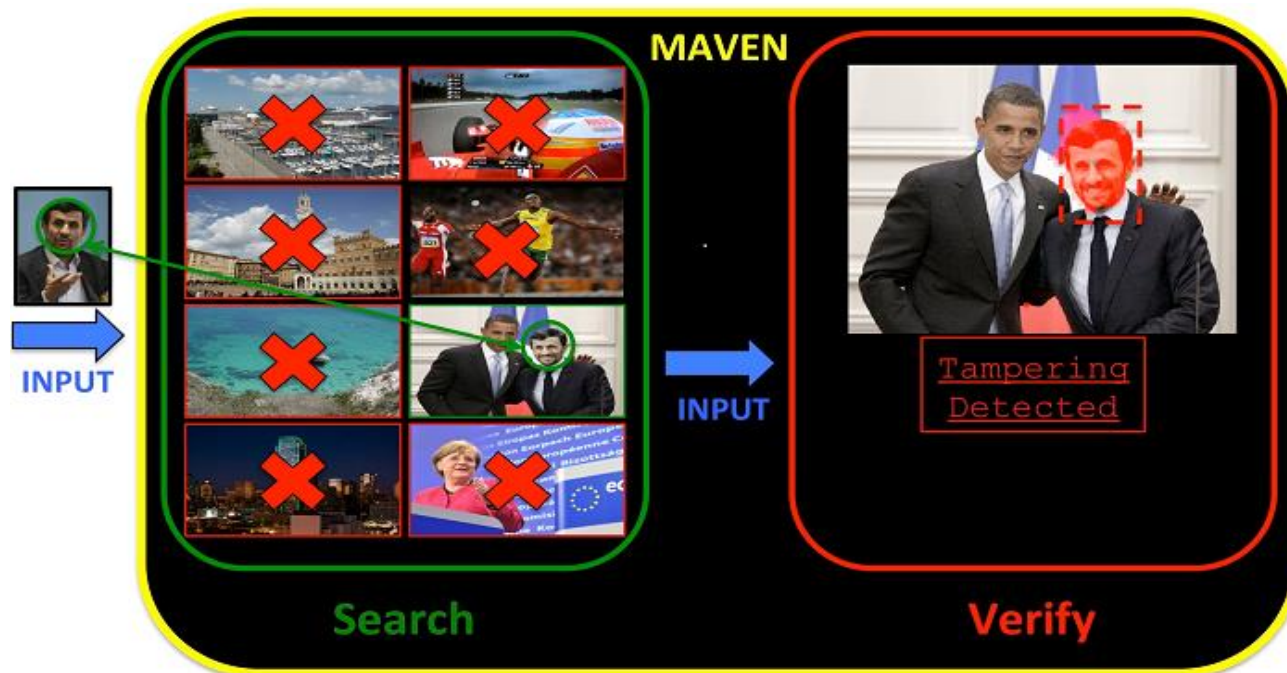
An EU-funded Research Project
(FP7, Research for the benefit of SMEs)
October 2013 – September 2015



Motivation

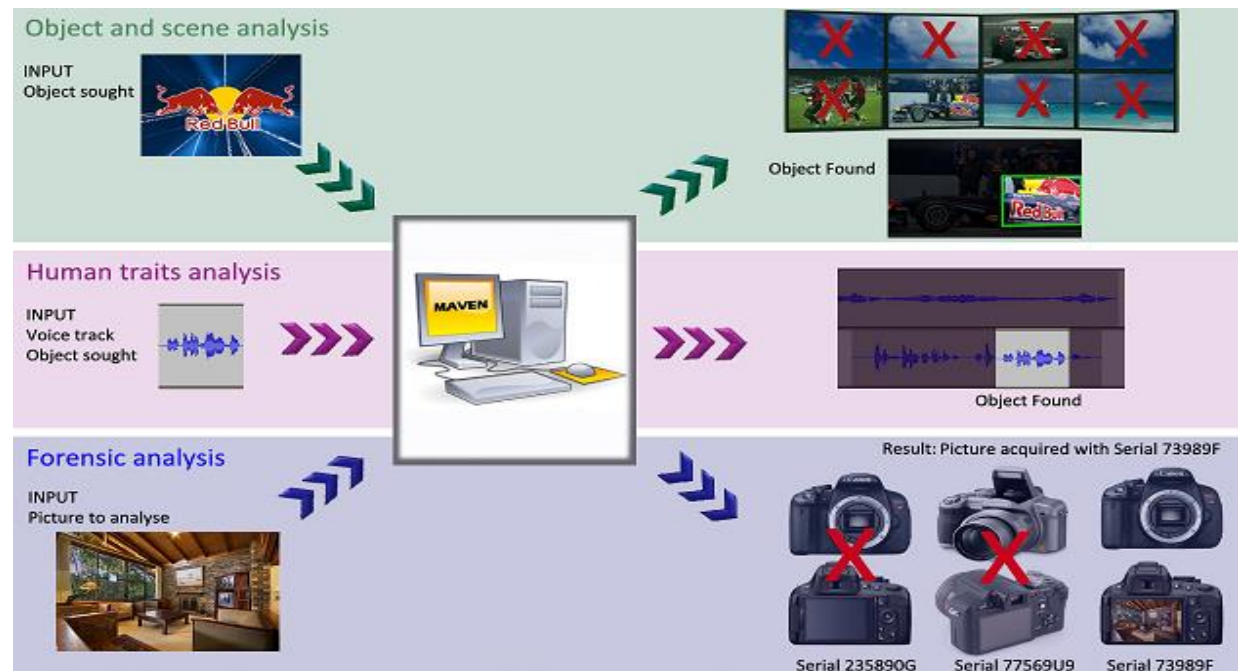
- Large amount of MM contents circulating in personal and industrial environments
- Integrity and authenticity verification are needed, in an efficient and scalable fashion
- Not all multimedia contents have the same degree of importance:
 - focus the analysis on certain “interesting” patterns occurring in the MM content such as persons, texts, specific objects

MAVEN concept: **search** and **verify**



Project goal

- Development of a set of tools for multimedia data management and authentication including:
 - **Search tools:** efficient search of patterns in multimedia contents
 - **Forensics tools:** authenticity verification of multimedia contents
- Such functionalities will be integrated in a modular software library, the **MAVEN suite**.



Target markets

- **Security domain:** it concerns the analysis of multimedia documents for law enforcement and legal purposes. Here, one of the main priorities is to prove (or, eventually, disprove) the authenticity of the documents under analysis.
- **Media domain:** the priority here is the development of automatic search and categorization functionalities for fast information retrieval from large digital archives.
- **Final beneficiaries of the results:** SMEs, law enforcement bodies, courtrooms, news agencies, insurance companies, broadcasting companies, companies and bodies that need to manage large digital libraries, ...

SME Partners

- **AMPED** (IT): develops and sells SW for image and video forensic analysis
- **Playence** (AU): develops custom solutions for searching within multimedia contents
- **XTREAM** (ES): specialized in big data management, analysis and prediction
- **ARTHAUS** (MK): software company developing web and mobile tailored solutions

RTD Partners

- **GRADIANT** (ES): [project coordinator], research group in Vigo with widespread coverage of IT topics
- **UNICA** (IT): group with strong background on computer science, machine learning, information retrieval
- **CNIT** (IT): inter-university consortium with strong background in information and communications technology

Verify: detailed objectives

- **Copyright protection**
use advanced watermarking techniques for linking a content to its creator
- **Informed Forgery Detection** given an image and a heavily retouched version, produce a map highlighting regions where changes concentrated
- **Blind Forgery Detection**
“classical” image/video forensic analysis

Search: detailed objectives

- **Text detection and recognition** - detect and recognize text within a scene, enabling automatic search and annotation
- **Human trait analysis** - analyze human traits for the spoken keyword detection from audio tracks and for the automatic detection and recognition of faces in image and video galleries.
- **Object detection and recognition** - detection of a particular content within image and video galleries, in particular for the recognition of company-logo and the automatically categorization of a scene within image and video galleries accordingly to a given content.

MAVEN final tools

Project results	RTD(s) involved			Interested SME(s)			
	CNIT	UNICA	GRAD	AMPED	PLY	ARTH	XTREAM
Forensic tool #1: image source identification	X					X	
Forensic tool #2: image integrity verification	X			X		X	
Forensic tool #3: video integrity verification	X			X			
Search tool #1: text localization and extraction		X	X		X		X
Search tool #2: spoken keyword detection			X		X		X
Search tool #3: face detection and recognition		X	X		X		X
Search tool #4: object and scene recognition		X			X	X	X

MAVEN first period results: FT#1

Image Source Identification

- 3 modules:
 - A device registration module, which extracts the Photo Response Non-Uniformity (PRNU) pattern from a specific camera device and computes its hash string, as its 'signature'.
 - A watermark embedding module, which inserts the PRNU hash as an imperceptible binary watermark into the photos taken by the photographer with his/her registered device.
 - A watermark detection module, which analyzes photos to determine whether they contain a specific previously embedded watermark.

MAVEN first period results: FT#2

Informed Image Integrity Verification (original vs retouched image)

- 2 modules:
 - A registration module based on ORB features, which aligns the retouched image and its original version, by means of keypoint detection.
 - A change detection module, which identifies the regions of the to-be-analyzed image which are significantly different from the corresponding original image, producing a change map. Different change detection modules were implemented, including image difference, image ratio, SSIM map and color difference.

Blind Image Integrity Verification (without the original image)

- It considers the image trustworthiness verification in a blind fashion, when only the to-be-analysed image is available for the forensic analysis. Several tools are considered:
 - Cut-and-paste forgery localization based on traces of double-aligned JPEG compression
 - Cut-and-paste forgery localization based on JPEG ghosts
 - Copy-move detection based on patch-match algorithm

MAVEN first period results: FT#3

Video integrity verification

- Detection of inter-frame forgeries, relying on a double compression detection algorithm. The implemented functionalities include the detection of double encoding using a method called Variation of Prediction Footprint.

MAVEN first period results: ST#1

Text localization and extraction

- A preliminary version of the Text Detection module has been implemented, and it has been tested with the ICDAR 2013 database. (F1-score value of 53%)
- A preliminary version of the Text Recognition module has been implemented, and it has been tested with the ICDAR 2013 database. (Word Recognition Rate of 50.6%)

MAVEN first period results: ST#2

Spoken keyword detection

- Databases for training: TIMIT for English language and Albayzin for Spanish language.
- A preliminary module for spoken keyword detection has been developed, able to train acoustic models from a phonetically annotated audio database and to look for single keywords in an audio file.
- Evaluation experiments: a set of acoustic models were trained using the training subset of TIMIT.

MAVEN first period results: ST#3

Face detection and recognition

Face detection in unconstrained settings.

- Databases for training. Preliminary module have been developed, using a cascade of classifiers. This cascade of classifiers has been trained using the Fddb database. Testing experiments have been conducted to estimate the performance.

Face recognition in unconstrained settings.

- Databases for training. Preliminary module for face recognition has been developed using the BSIF features. The module estimates the similarity between the input face and a set of stored templates. Testing experiments have been conducted by calculating the Rank-N rate on the NIST Special Database 32.

MAVEN first period results: ST#4

Object and scene recognition

- A preliminary version of the Object and Logo Recognition module has been implemented, and it has been evaluated on the Flickr32 database. (recall of 59.37%)
- A preliminary version of the Scene Recognition module has been implemented, and it has been evaluated on the SUN database. (accuracy on the worst category is around 40%, average accuracy is around 68.6%).

MAVEN Contacts

If you are interested in the MAVEN Project activities, events, results, etc. please contact us at:

info@maven-project.eu

You can also visit the web site:

<http://www.maven-project.eu/index.html>



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Thanks for your attention!
...any question?