

AI Deep Learning and Data Security in the Internet of Everything

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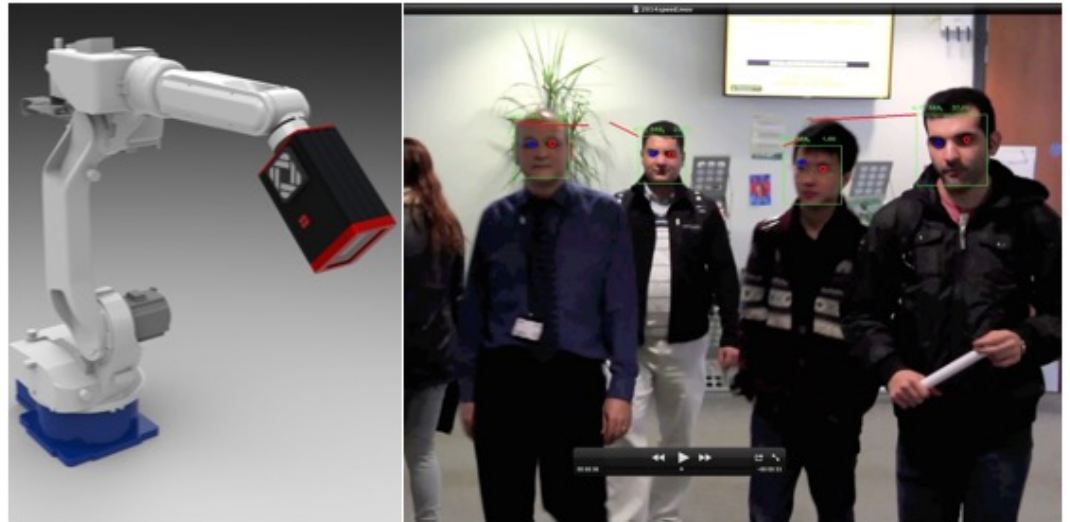
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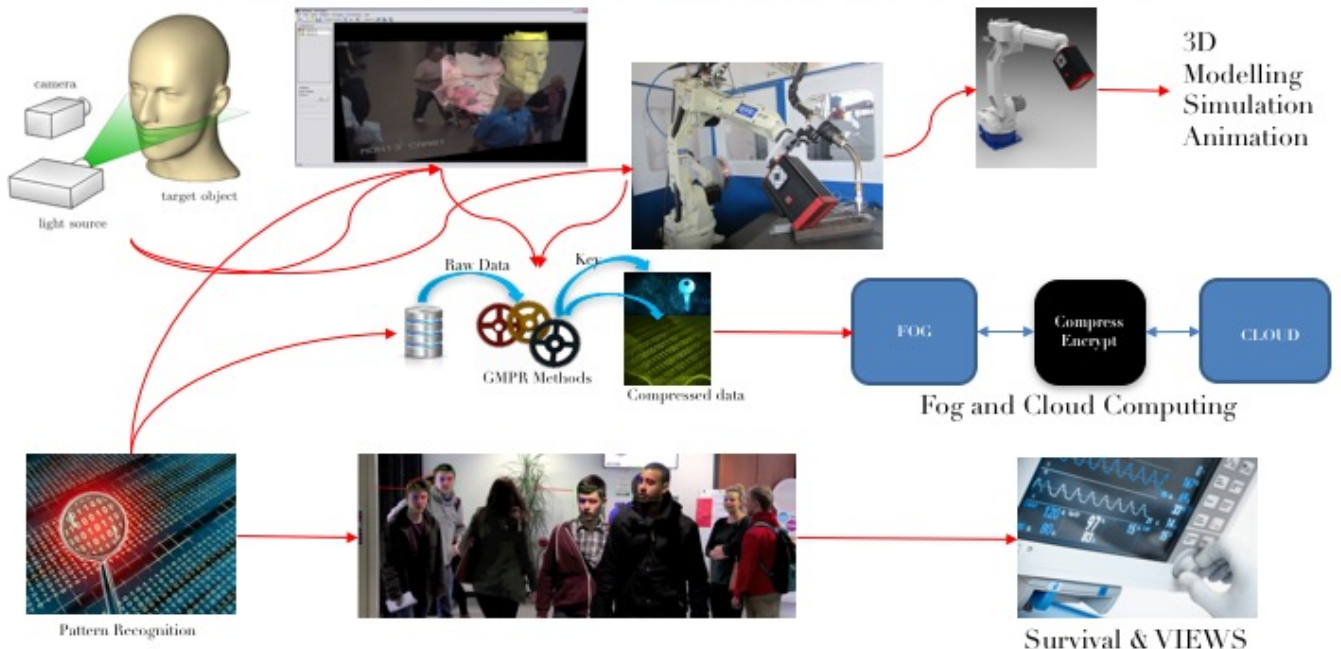
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AI Deep Learning and Data Security in the Internet of Everything

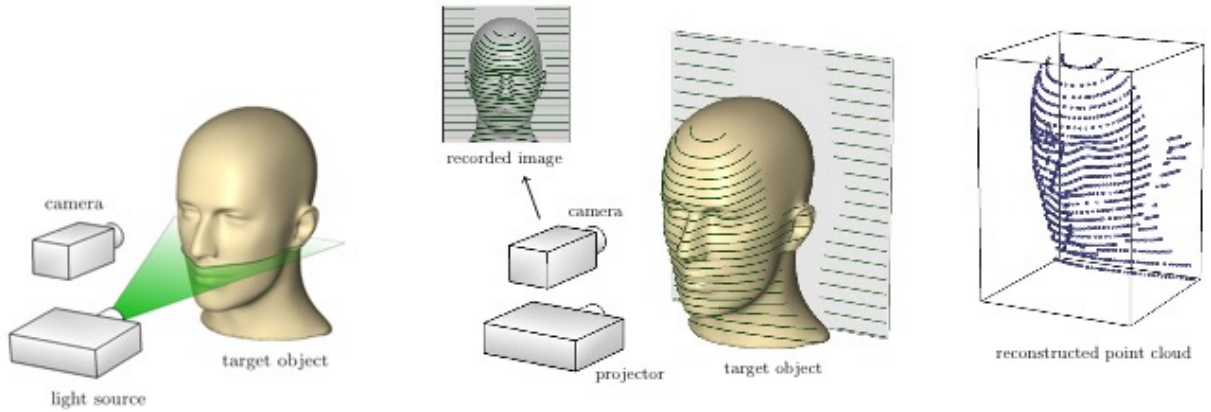
Professor Marcos Aurelio Rodrigues



From 3D Reconstruction to Medical to Security *Underlying technology is pattern recognition*



The GMPR 3D scanning technologies *3D with single image*



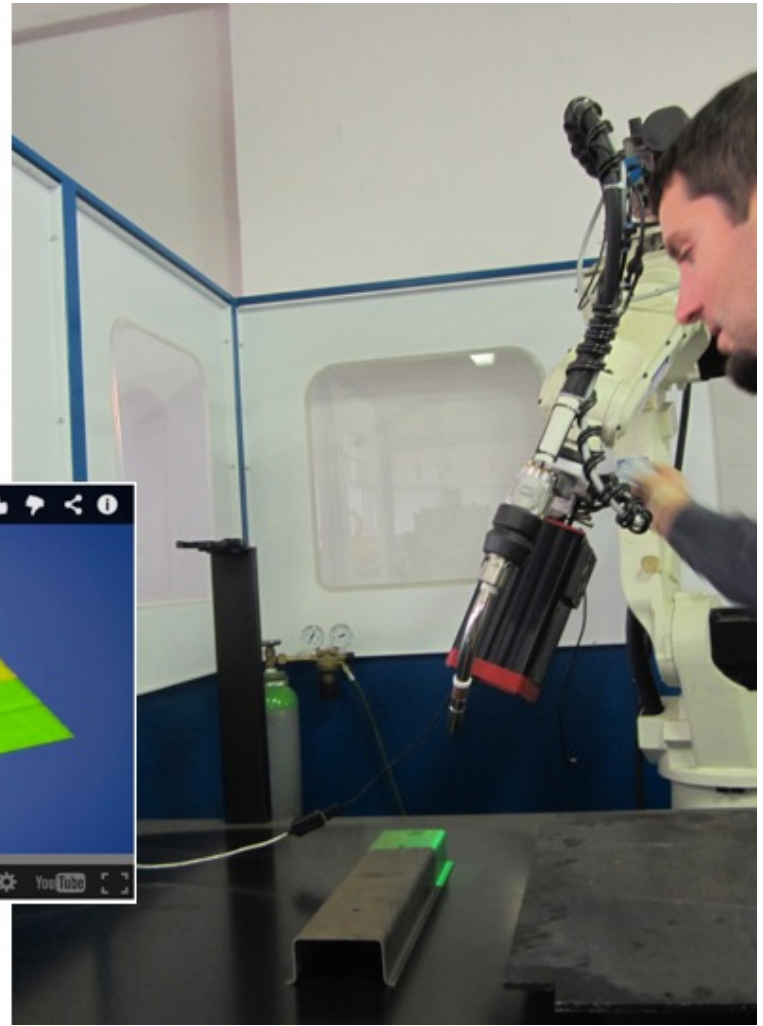
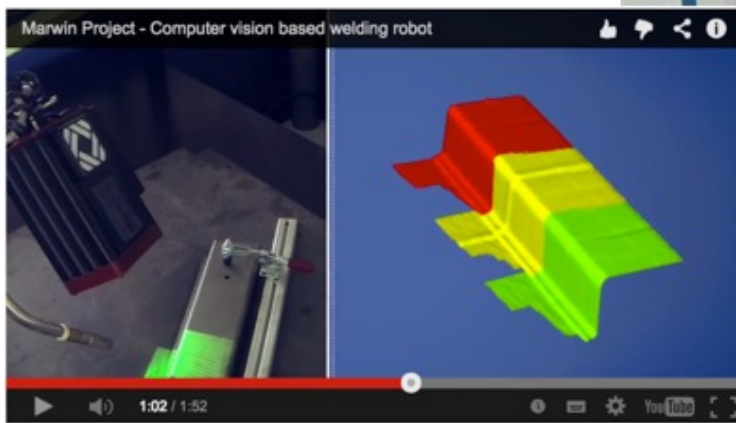
Each light plane is uniquely
detected by original algorithms



**MARWIN Project: full design
integrated into a robotic arm**
The actual robotic cell



Scanning a part



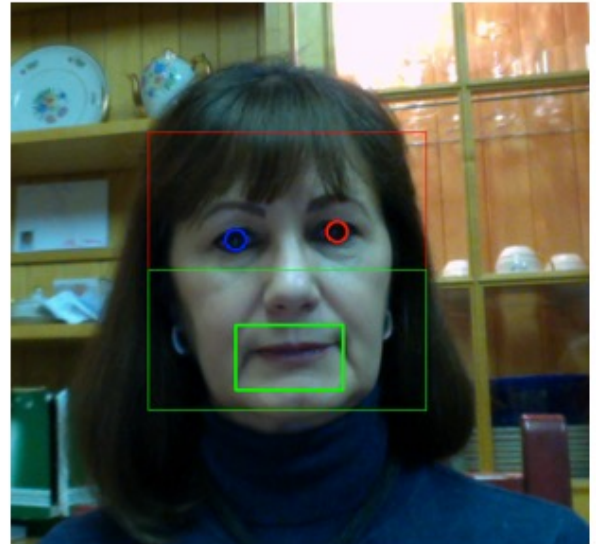
The ADMOS Project
Gender classification and age estimation



Client Side Software Development *Firmware and control s/w development*

Real time processing:

1. face detection and tracking
2. eye tracking
3. other feature tracking (mouth, nose)
4. cropping the various face-ROI
5. gender classification
6. age estimation
7. save statistical info to an xml file
8. transmit to server at periodic intervals



Applying binary patterns to face images *Visualizing the differences on images*



Input image



LBP 3x3



Census 3x3



Modified
Census 3x3



Census 5x5



Modified
Census 5x5

Comparative analysis of binary patterns

Raw histograms

Transformed histograms by DCT

Transformed histograms by DWT



Original



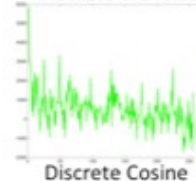
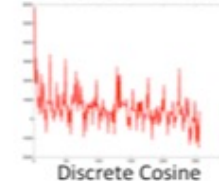
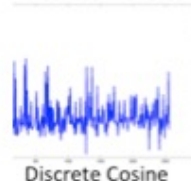
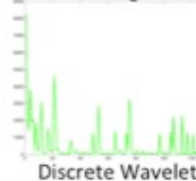
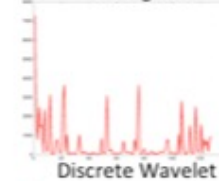
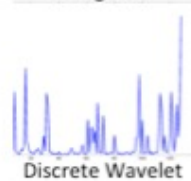
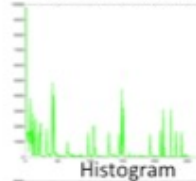
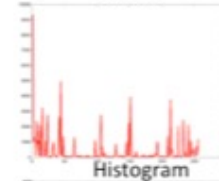
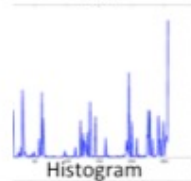
LBP



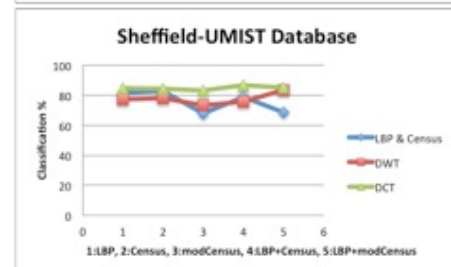
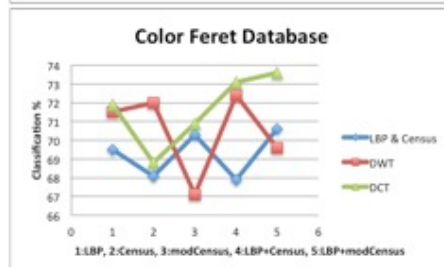
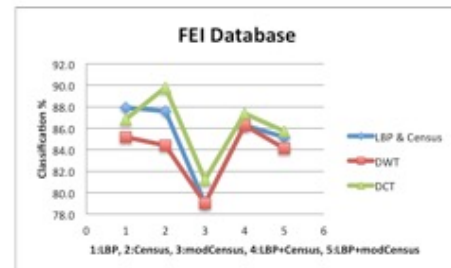
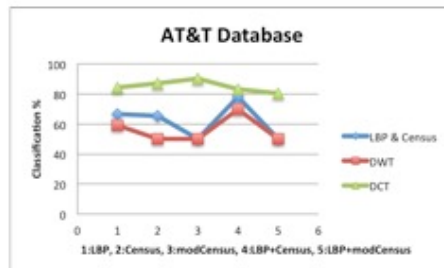
Census



Modified Census

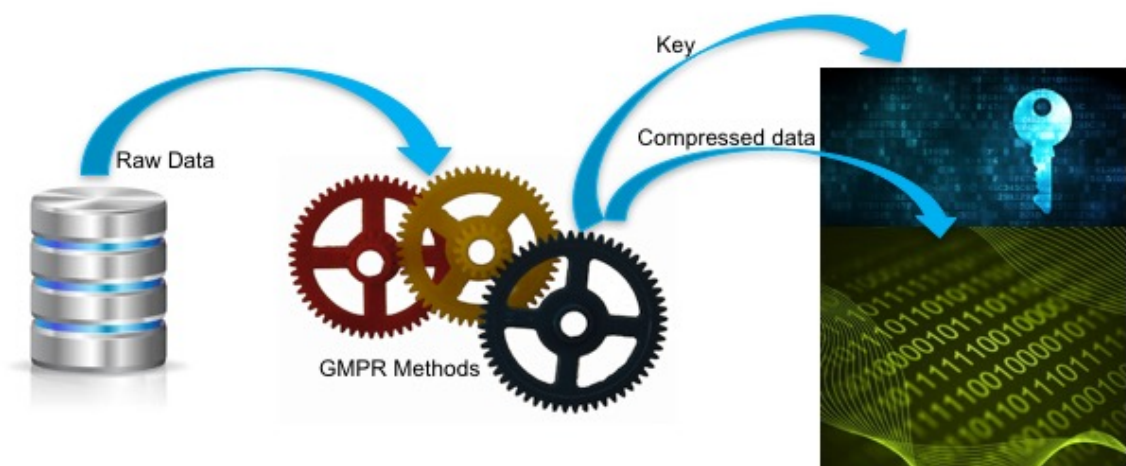


Classification results Four public databases



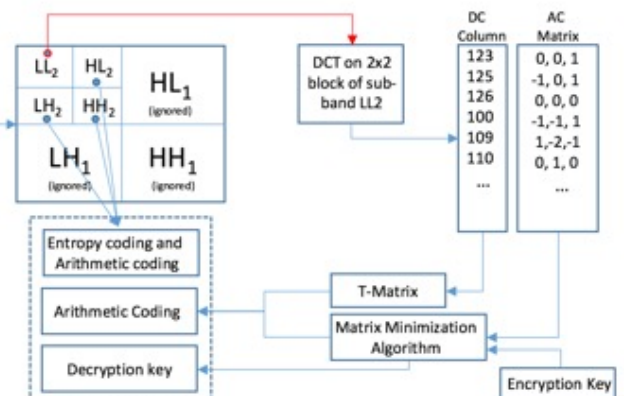
GMPR compression-encryption

Automatic generation of encryption key



The GMPR method

Automatic generation of compression-encryption key

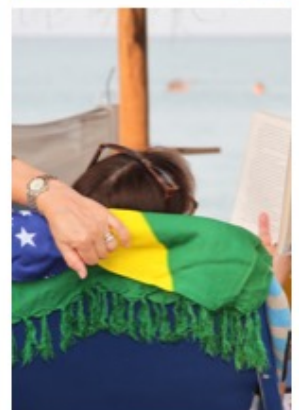
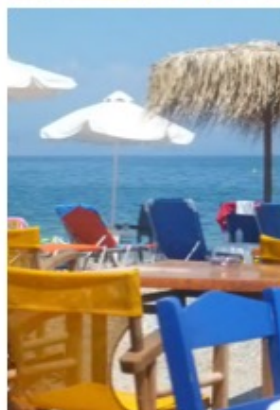
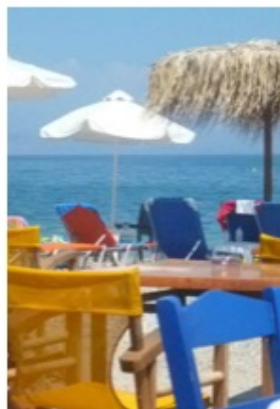
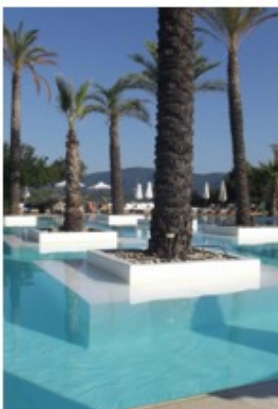
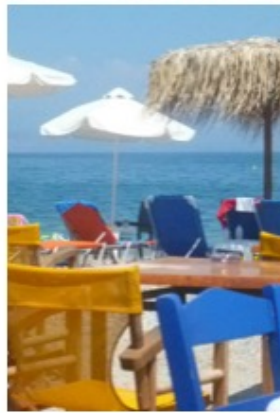
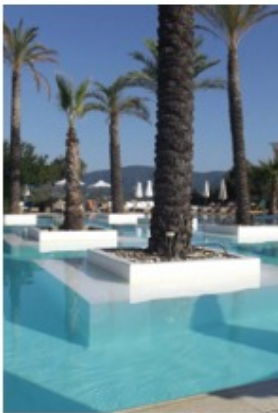
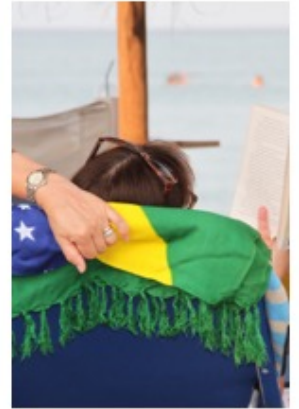
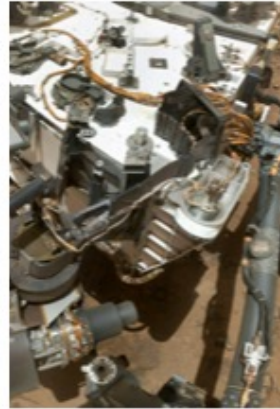
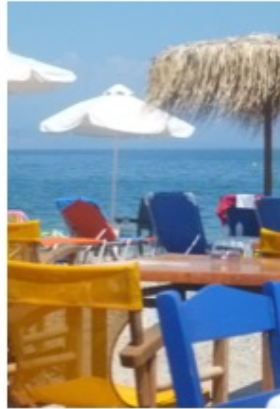
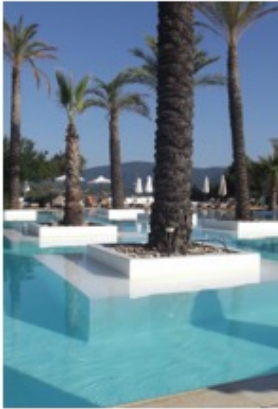


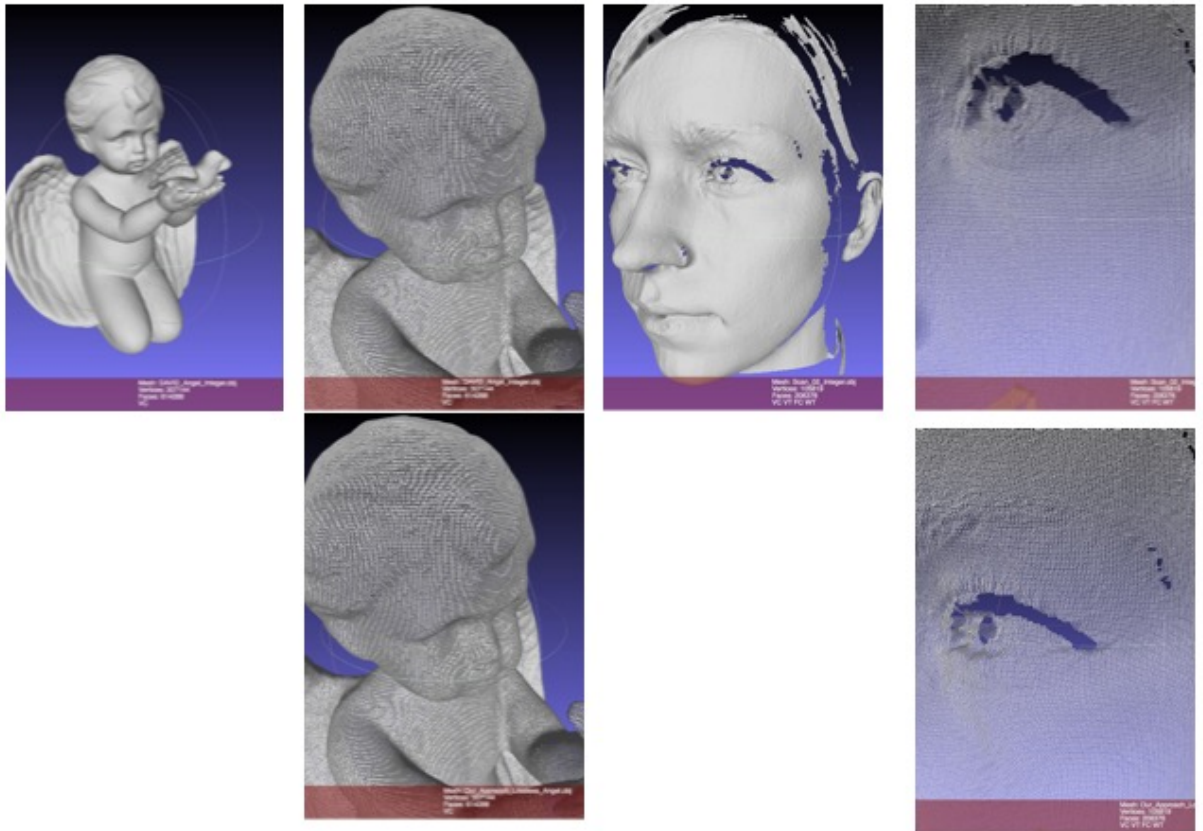
Main novel steps:

1. Data divided into blocks
2. Delta or differential process
3. Triplet encoding into a single value

Many transformations can be applied before or after, e.g.:

DCT, DST, DWT, DFT,
Quantization,
Entropy coding,
Arithmetic coding, etc.

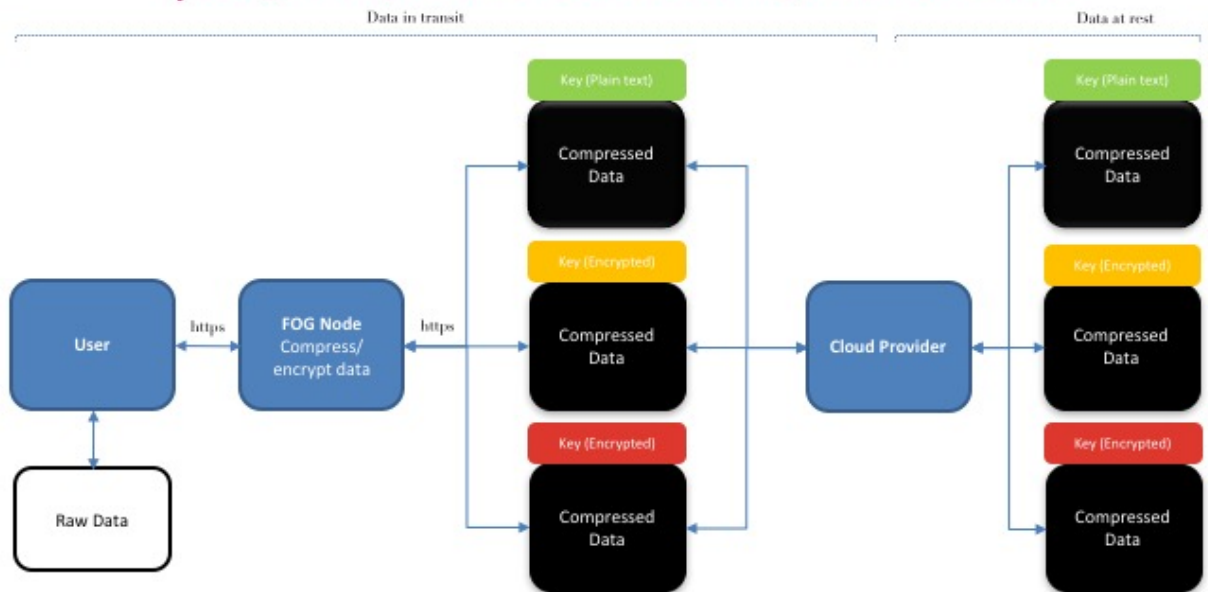




Comparison of Lossy and Lossless compression with popular Unix/Linux compression utilities

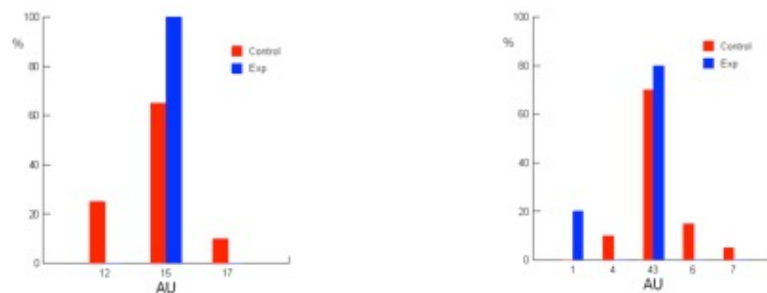
File	Original size (MB)	GMPR Method (MB)	Lempel-Ziv-Welch (MB)	xz (MB)	gzip (MB)	bzip2 (MB)
Angel (floating point)	24.7	2.670	7.3	3.1	5.5	5.3
Face (floating point)	14.0	0.290	4.7	1.2	3.3	2.6
Average compression ratio		94% (lossy)	69%	90%	78%	81%
Angel (integer)	19.1	3.35	6.3	2.7	4.6	4.8
Face (integer)	12.0	0.556	4.1	0.723	2.7	2.1
Average compression ratio		89% (lossless)	66%	90%	77%	79%

Vision for Fog and Cloud Computing Only compressed data are kept in the Cloud



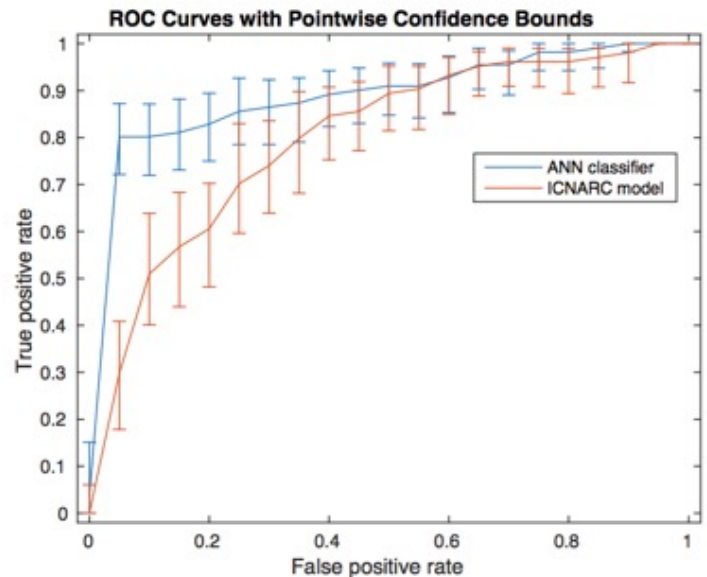
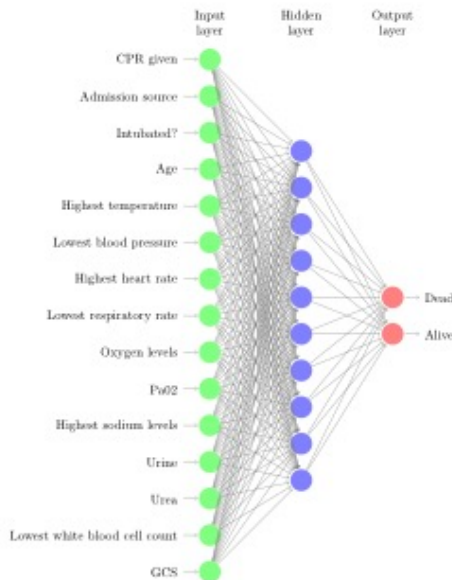
All data processing and enforcement of company's security policy are performed in the Fog

A novel method for identification of patients at risk of deterioration using FACS



The research has demonstrated for the first time that patients at risk of deterioration and terminally-ill have similar patterns of AU in the lower and upper parts of the face, with peak frequencies of AU 15 and 43 respectively

An improved classifier for mortality prediction in adult critical care admissions



SHENFIELD, Alex, RODRIGUES, Marcos, VALENTINE, D, LIU, D and MORENO-CUESTA, Jeronimo (2015). *An improved classifier for mortality prediction in adult critical care admissions*. *Journal of the Intensive Care Society*, **16** (4), 118.

Future Directions GMPR main priority areas

Medical engineering:

- Deep Learning: survival prediction with 100s thousands patient data
- VIEWS: computer vision FACS analysis to detect patients at risk of deterioration in critical care

3D Reconstruction:

- Collection of 3D facial data from up to 5,000 subjects

AI and pattern recognition:

- Deep Learning: intrusion detection from network packet data
- Deep Learning: 2D and 3D face recognition

Security:

- Tracking of financial transactions
- Intrusion detection
- Data compression and cloud security