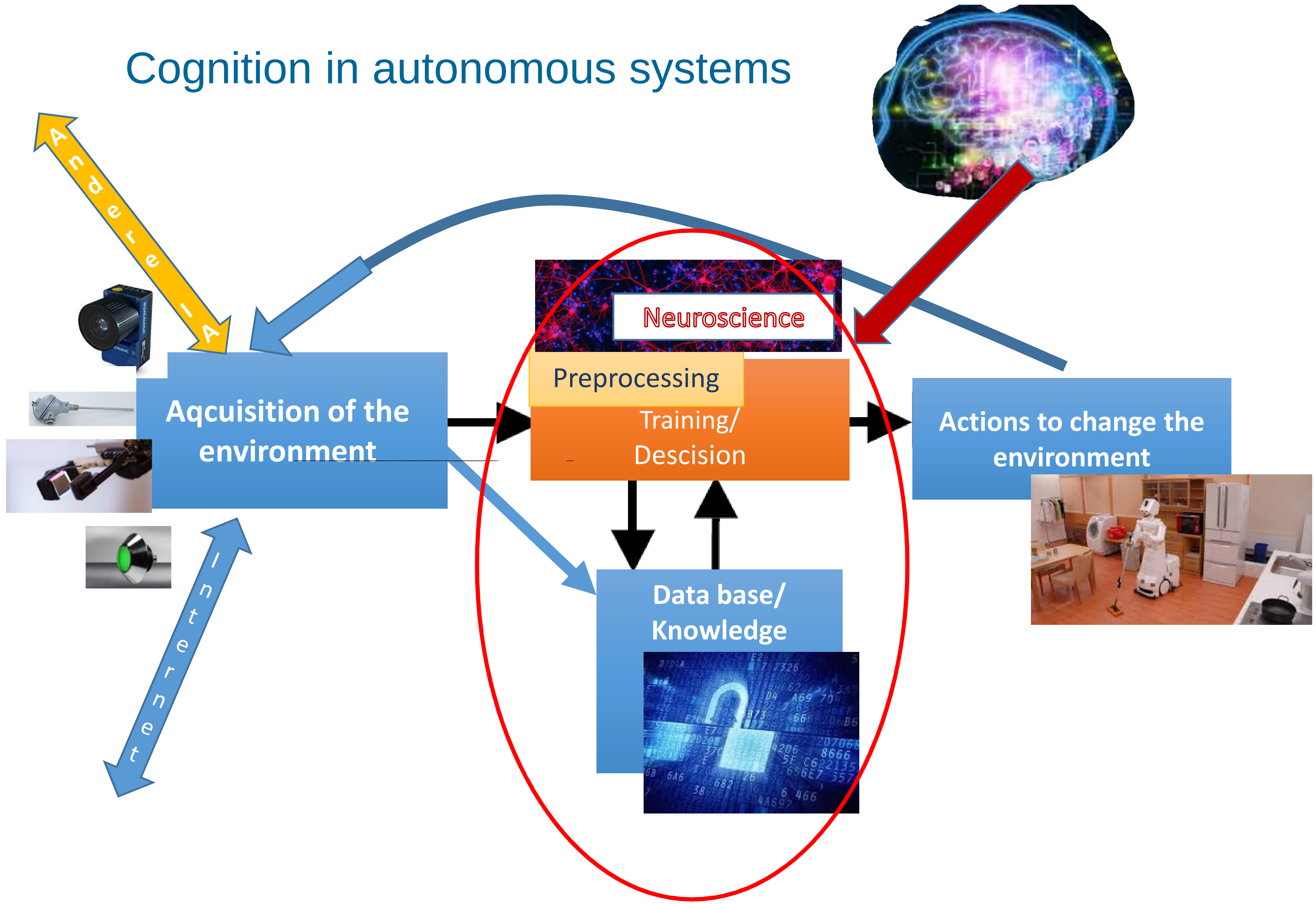
Trends, challenges and applications of cognition in modern autonomous systems

The Fifteenth International Conference on Autonomic and Autonomous Systems ICAS' 2019

Keynote Speaker: ***Assoc. Prof. PhD Irina Topalova***

- FaGEEIM, Technical University Sofia, Bulgaria,
- University of Communications and Posts, Sofia, Bulgaria



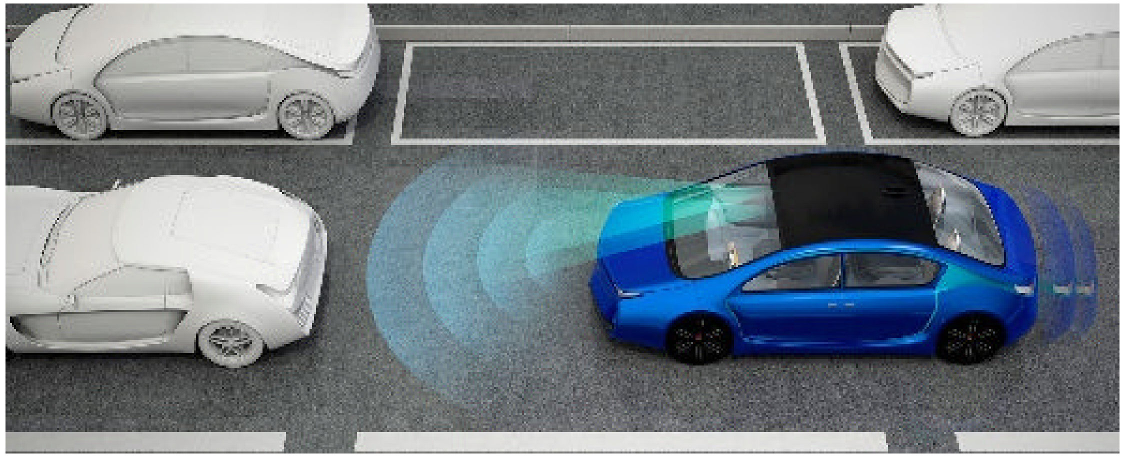
Cognition in autonomous systems
Andere IA
Internet
Aqcuisition of the environment
Neuroscience
Preprocessing
Training/ Descision
Actions to change the environment
Data base/ Knowledge

TOP-3 TRENDS THAT WILL DRIVE THE MARKET FOR AUTONOMOUS VEHICLES

➢ 1) Real-time route optimization

Connected together with ***Vehicle-to-Vehicle (V2V)*** and ***Vehicle-to-Infrastructure (V2I)*** mechanisms.

Enables driverless vehicles to gain real-time information on the condition of the roads as well as exchange protection and mobility information with the surrounding infrastructure and redirect the routes accordingly.



➢2) Increased lane capacity

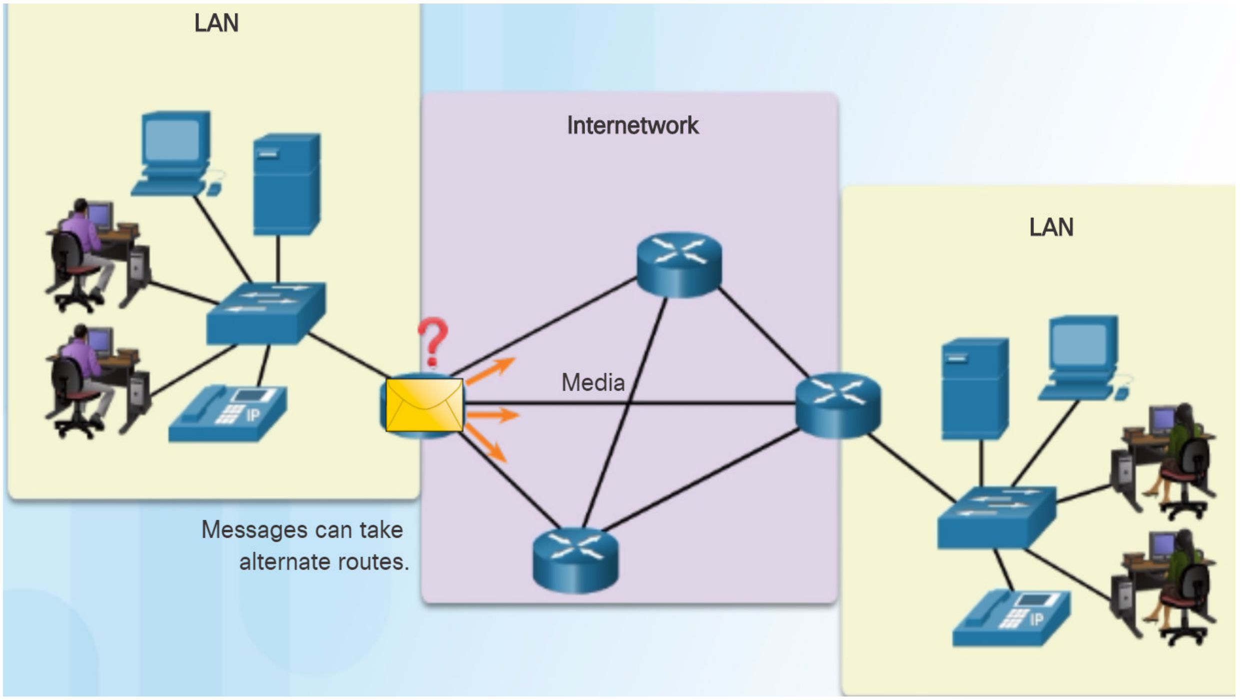
This technology adjusts the vehicle's speed mechanically to ensure a safe distance between the vehicles on the road. These technologies will ***optimize the lane capacity*** and ***reduce accidents***, ***ensuring greater passenger comfort and safety.***

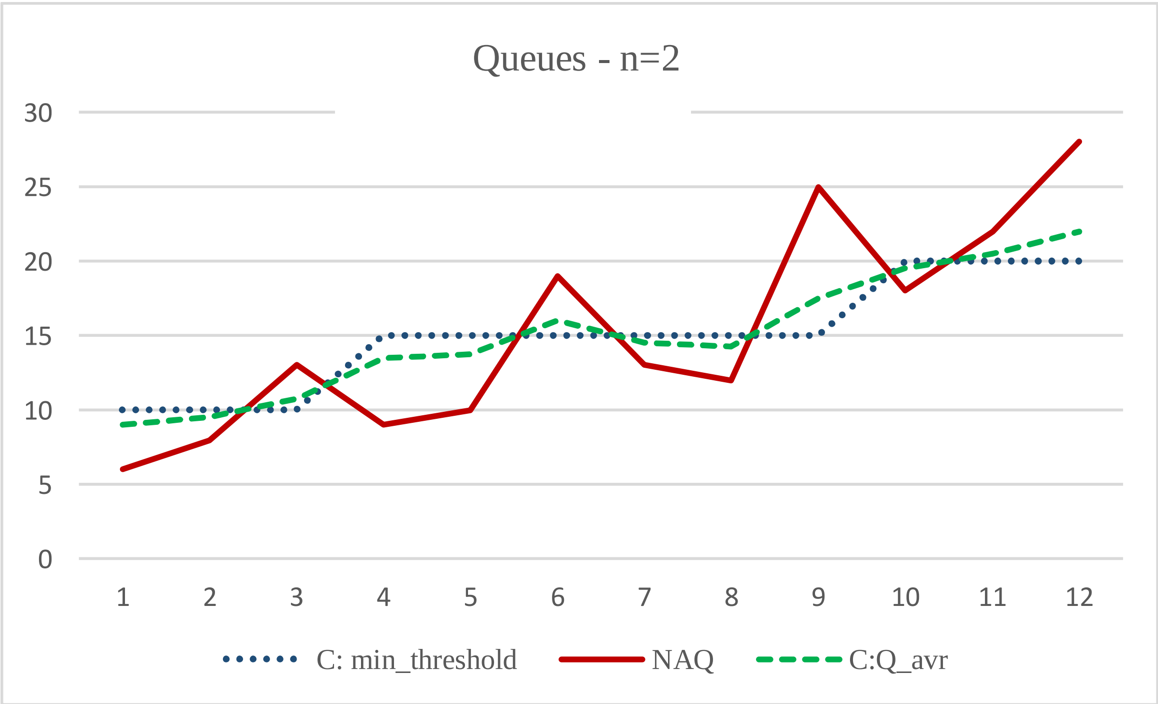
➢3) Reduced energy consumption

Autonomous vehicles ***are lighter*** than the conventional automobiles.

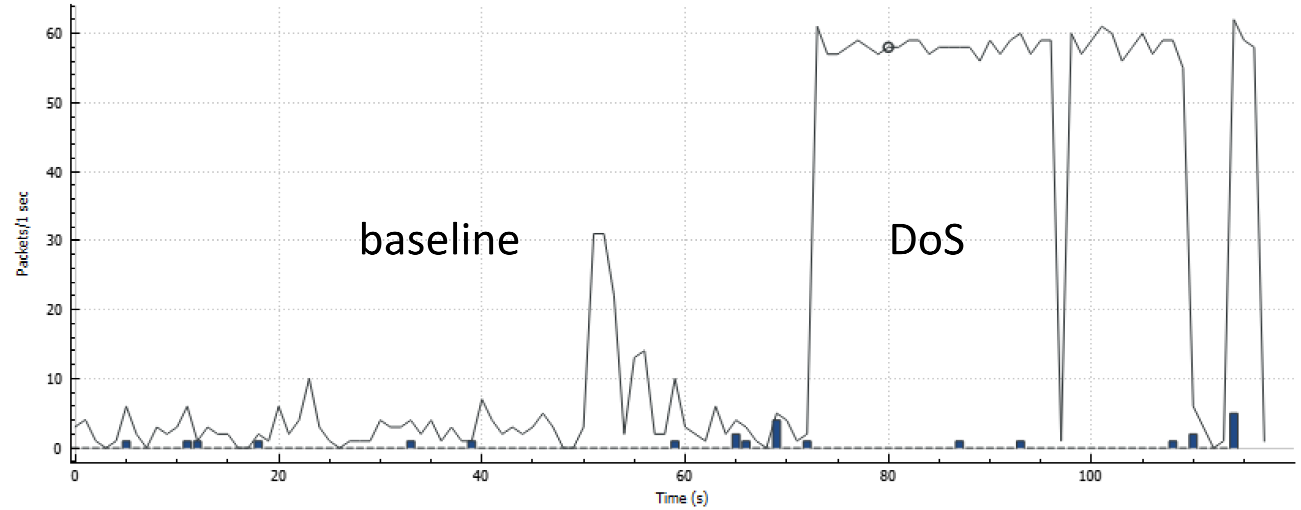
Thanks to the lightweight composites used for building the modern, further aided ***eco-friendly driving technologies*** and ***practices as smooth deceleration and acceleration.***

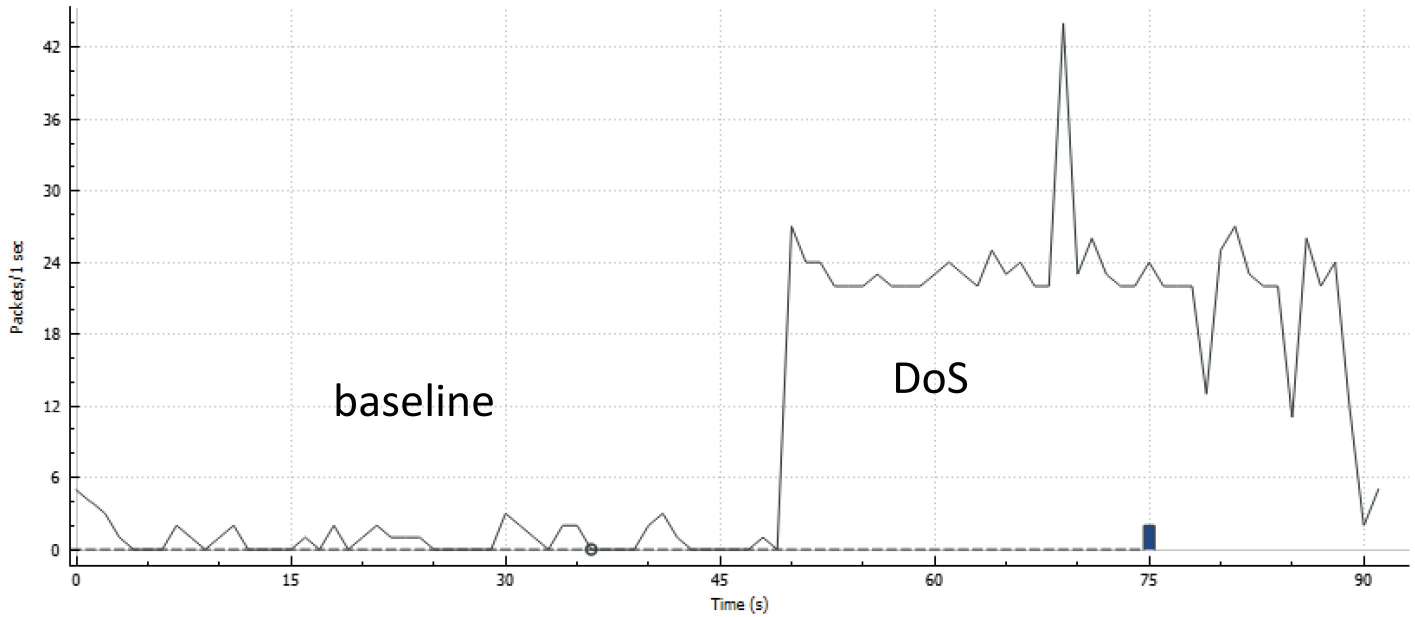
1. Adaptation of new added network devices to automatically adjust their QoS parameters to the backbone ones;
2. Predict the congestion and early traffic redirection





Resolving Deny of Service attacks (DoS)





Cognitive robotics - trends

Summarized functional abilities needed for cognitive robots:

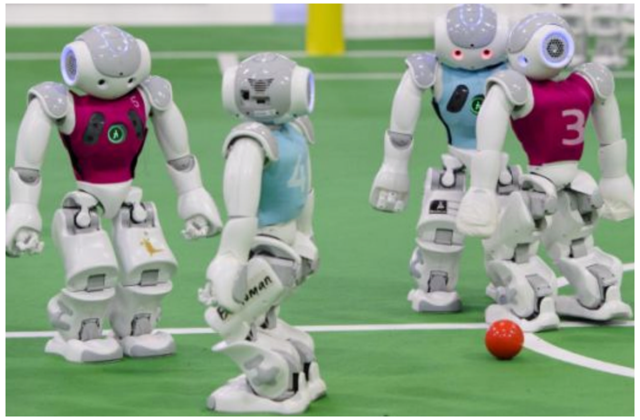
- They have to operate ***reliably and safely around humans*** and they will be able to explain the decisions they make;

- ***Knowledge acquisition and generalization.*** Cognitive robots will ***continuously acquire new knowledge and generalize that knowledge so that they can undertake new tasks by generating novel action*** policies based on their history of decisions.

- ***Adaptive planning***. Cognitive robots will be able to ***anticipate events*** and ***prepare for them in advance***. They will be ***able to cope with unforeseen situations***, recognizing and handling errors

- ***Personalized interaction***. (understanding of the person's preferences)

Cognitive robots will ***personalize their interactions with humans, adapting their behaviour and interaction policy to the user's preferences, needs, and emotional or psychological state.***



- **Self-assessment**. They will be able to assess the quality of their decisions.
- **Learning from demonstration**. Cognitive robots will be able to learn new actions from demonstration by humans and they will be able to link this learned knowledge to previously acquired knowledge of related tasks and entities.
- **Evaluating the safety of actions.** When they learn a new action, cognitive robots will take steps to verify the safety of carrying out this action.
- **Knowledge transfer to other robots.** Even to those having a different physical, kinematic, and dynamic configurations and they will be able to operate seamlessly in an environment that is configured as an internet of things (IoT).
- **Collaborative action**. Cognitive robots will be able to communicate their intentions to people around them and, vice versa, they will be able to infer the intention of others, i.e. understanding what someone is doing and anticipating what they are about to do.

In my opinion, artificial intelligence can not be better than the biological, it will only try to imitate it. This is because the people are the ones who set the algorithm of behaviour and the robot self-learning is controlled.

• ***Saving risk*** by the inspection of high tension electrical towers with **U**nmanned **A**erial **V**ehicles (UAVs).

• ***Utilizing drones for resource management and fire management*** missions.

• ***Delivery of critical supplies*** like medicine to remote areas.

• ***Wireless internet hotspots to restore service after a natural disaster.***

•The use of a ***thermal imaging camera to find a lost person in remote areas.***

DRONs

fixed wing or

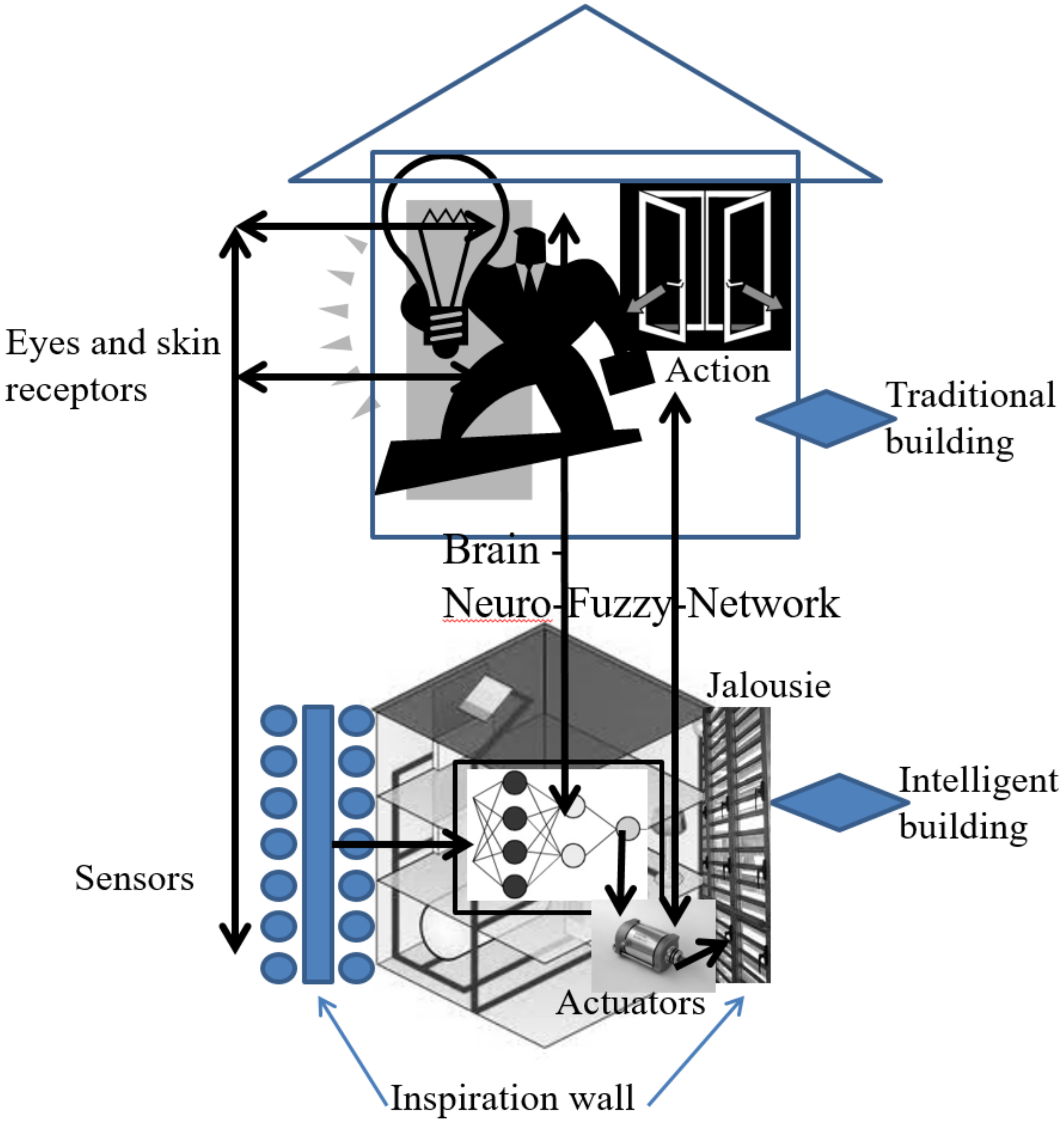
rotary wing (planes and helicopters)

TRENDs

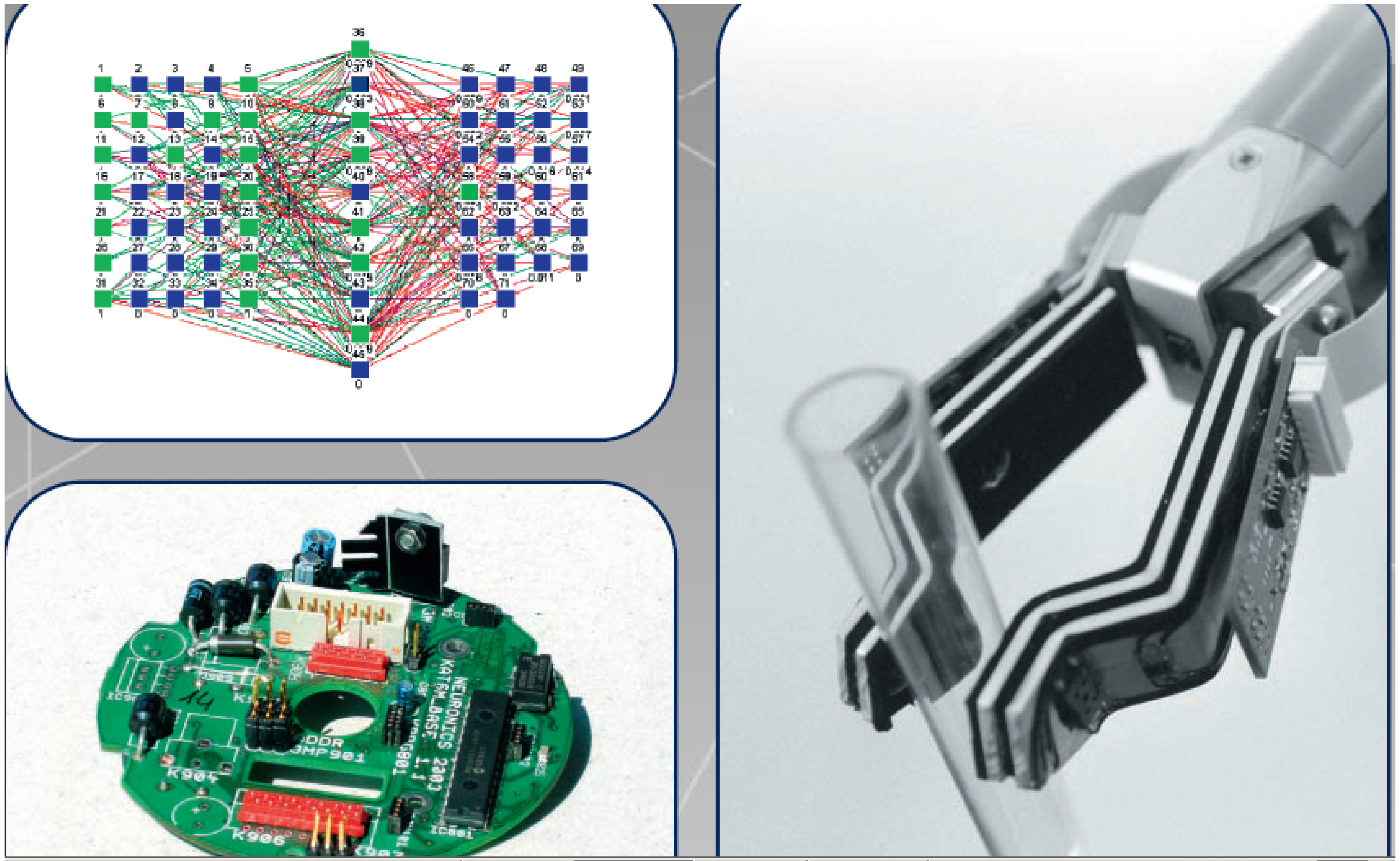
- Some investment organizations have predicted that the sales of civilian **UAV** will maintain an annual growth rate of 50% or more.
- Can not only fly along routes autonomously, but also ***detect and avoid obstacles in real time.***
- Some of them can ***fly in formation and cooperate with each other autonomously***

Spatially Targeted Communication

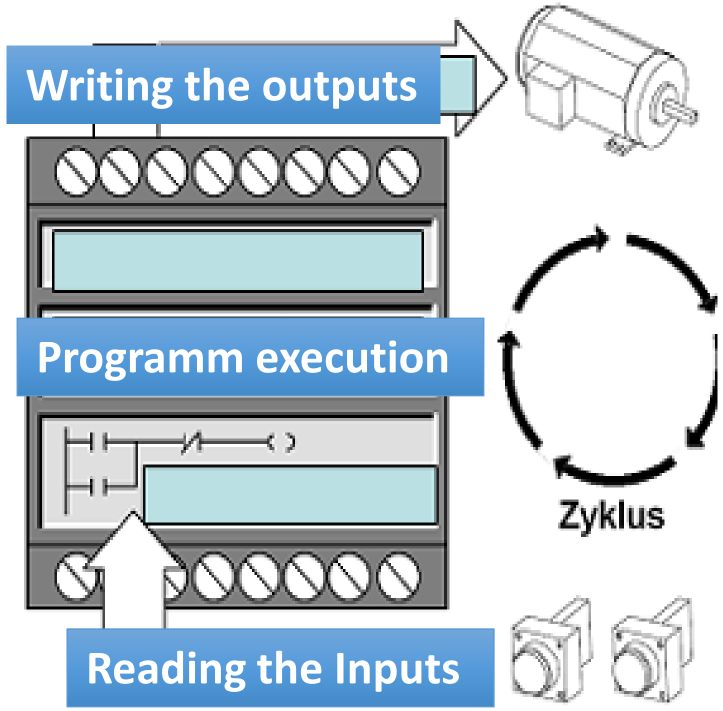
Intelligent breading buildings

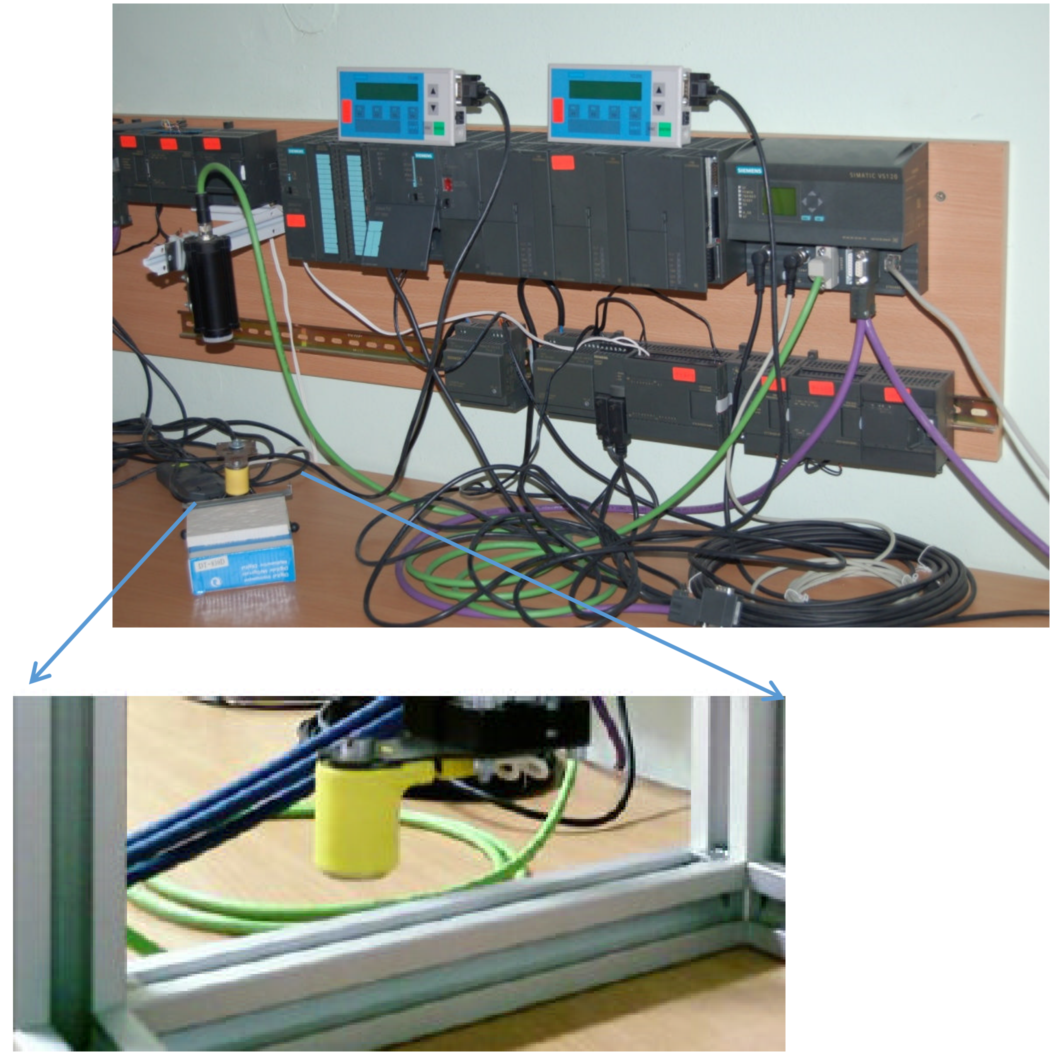


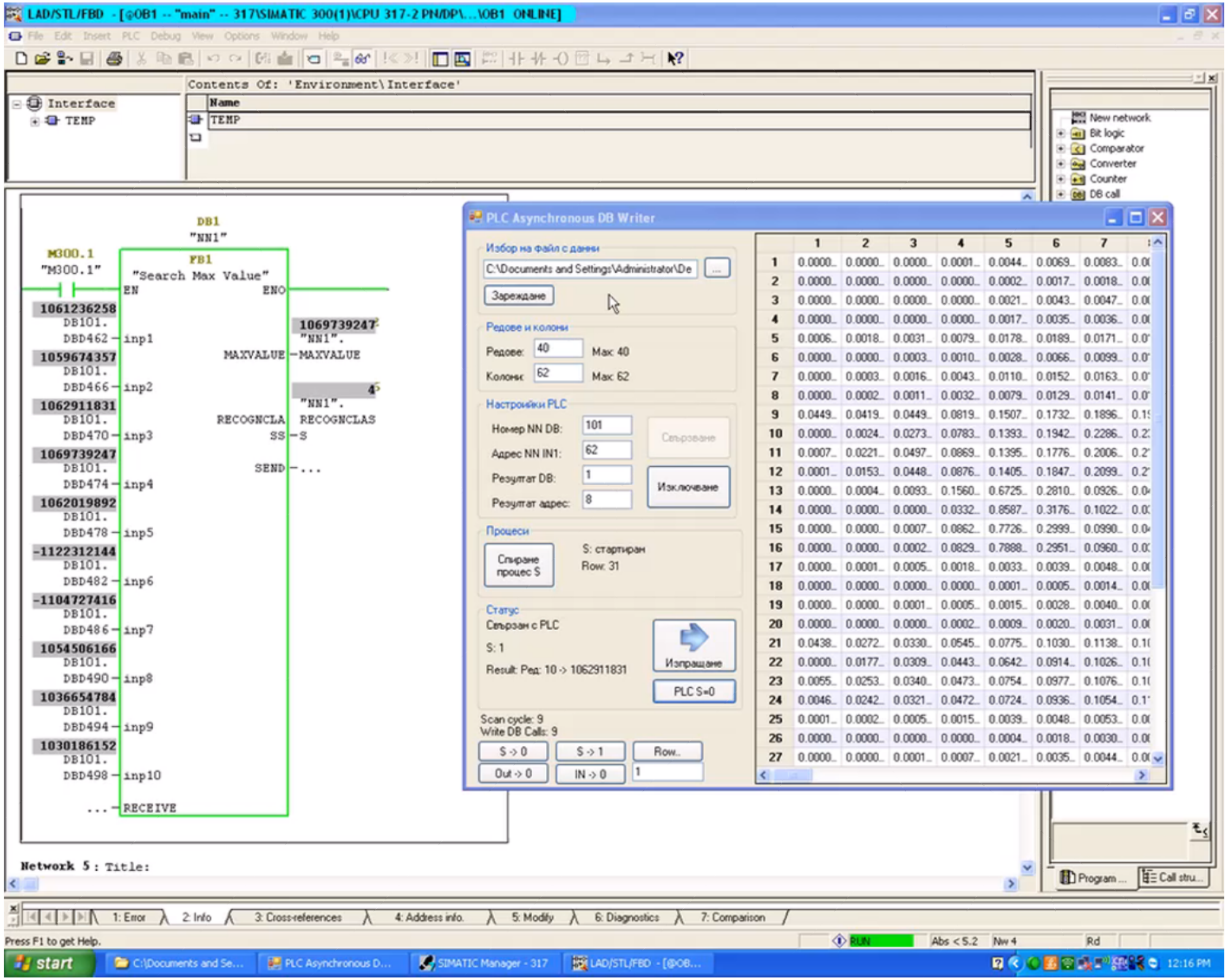
FPGA with implementation of a neural network



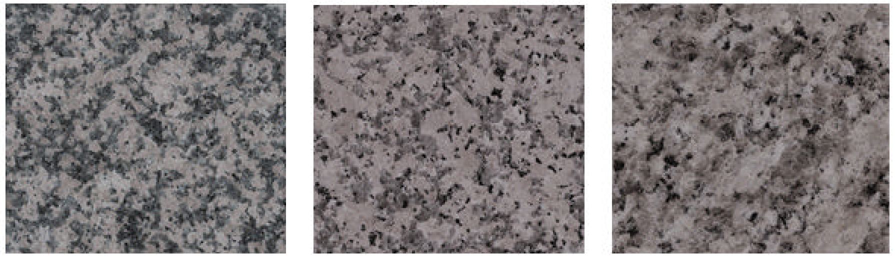
Real-time NN implementation in Programmable Logic Controllers (PLCs)

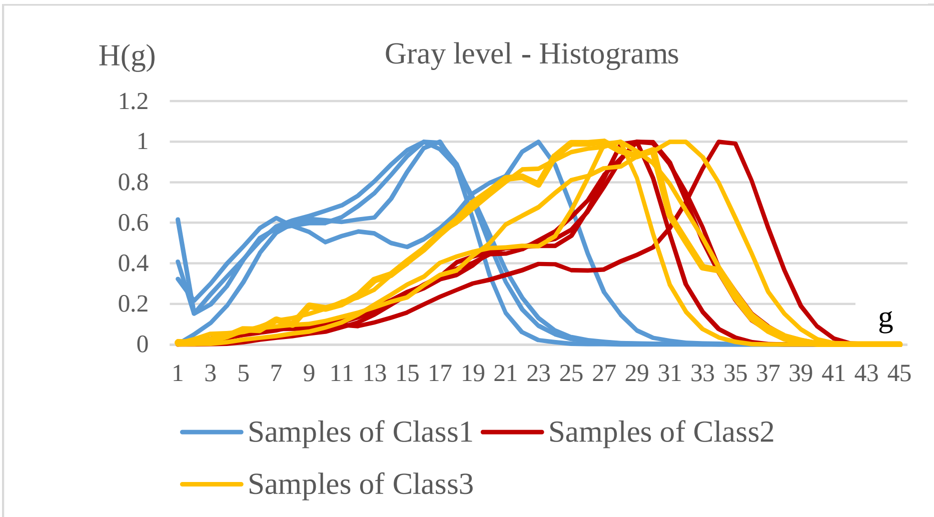


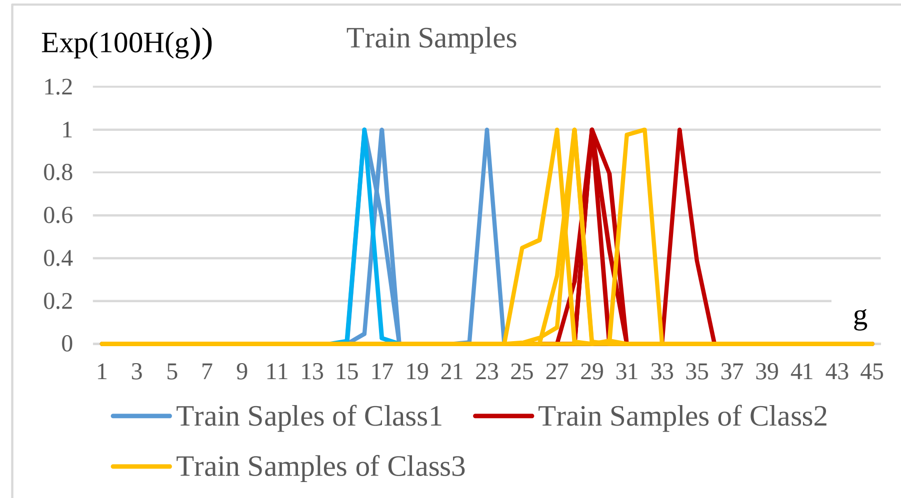


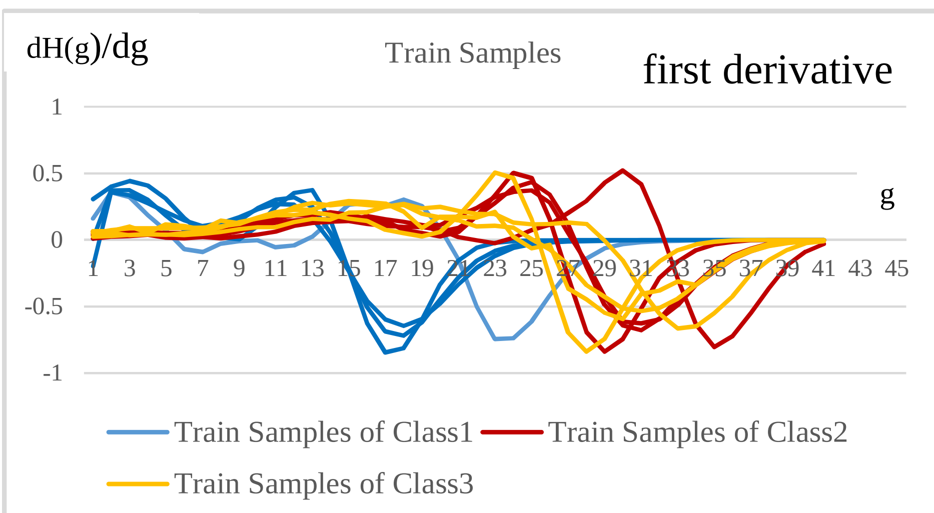

LAD/STL/FBD - [@OB1 -- "main" -- 317\SIMATIC 300(1)\CPU 317-2 PN/DP\...\OB1 ONLINE]
File Edit Insert PLC Debug View Options Window Help
Contents Of: 'Environment\Interface'
Interface
TEMP
Name
DB1
"NN1"
M300.1
"M300.1"
FB1
"Search Max Value"
EN
ENO
MAXVALUE
RECOGNCLA
SS
SEND
RECEIVE
Network 5 : Title:
PLC Asynchronous DB Writer
Избор на файл с данни
C:\Documents and Settings\Administrator\De
Зареждане
Редове и колони
Редове: 40 Max: 40
Колони: 62 Max: 62
Настройки PLC
Номер NN DB: 101
Адрес NN IN1: 62
Резултат DB: 1
Резултат адрес: 8
Свързване
Изключване
Процеси
Спиране процес S
S: стартиран
Row: 31
Статус
Свързан с PLC
S: 1
Result: Ред: 10 -> 1062911831
Изпращане
PLC S=0
Scan cycle: 9
Write DB Calls: 9
S -> 0
S -> 1
Row..
Out -> 0
IN -> 0
New network
Bit logic
Comparator
Converter
Counter
DB call
1: Error
2: Info
3: Cross-references
4: Address info.
5: Modify
6: Diagnostics
7: Comparison
Press F1 to get Help.
RUN
start
SIMATIC Manager - 317
12:16 PM

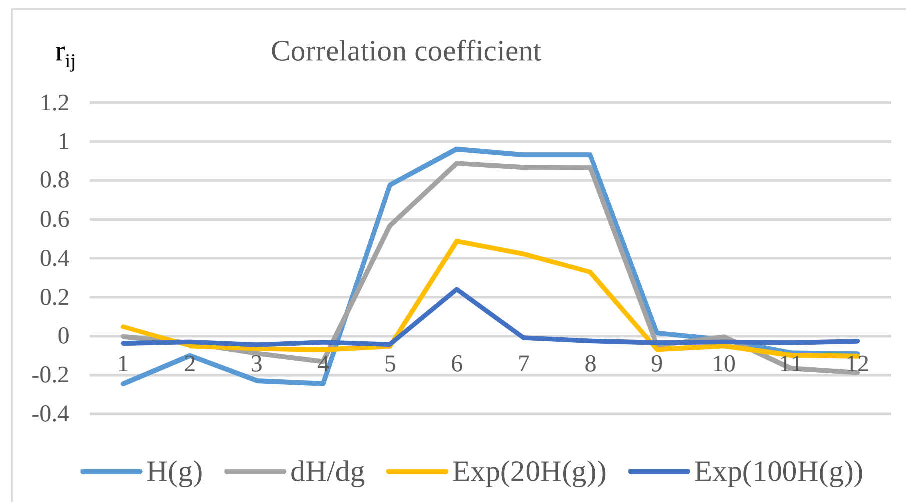
Do we need Input Data pre-processing ?



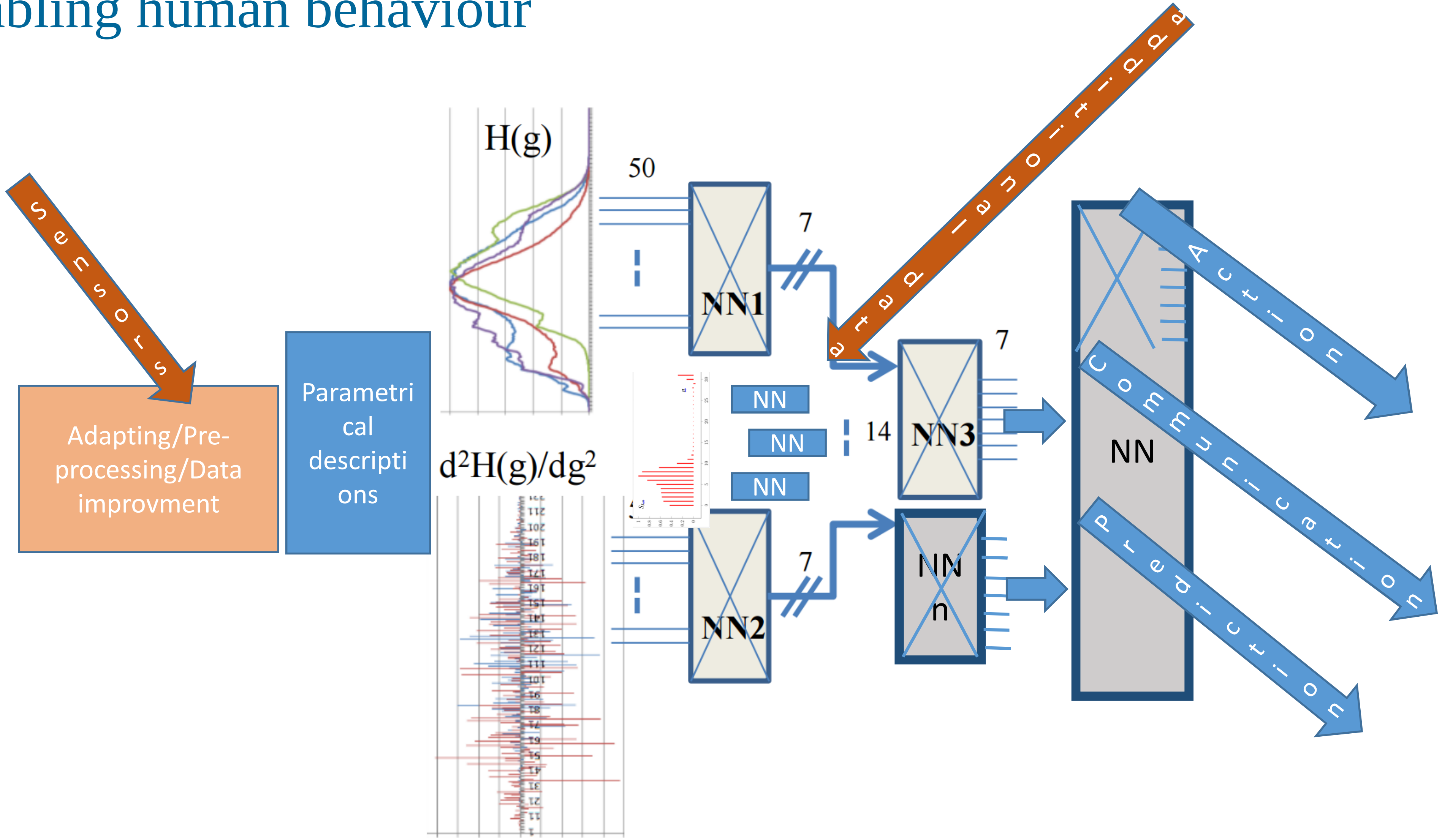


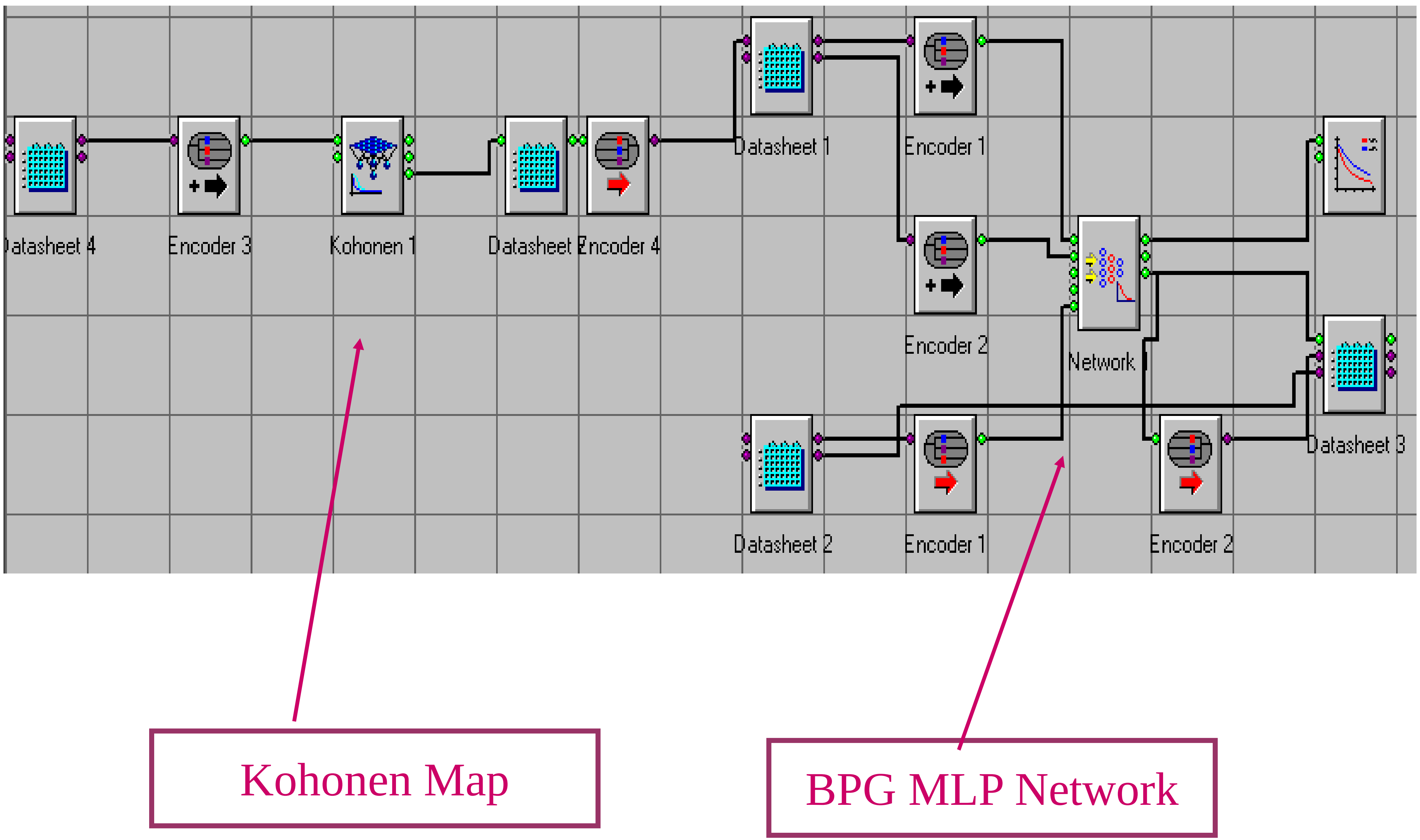


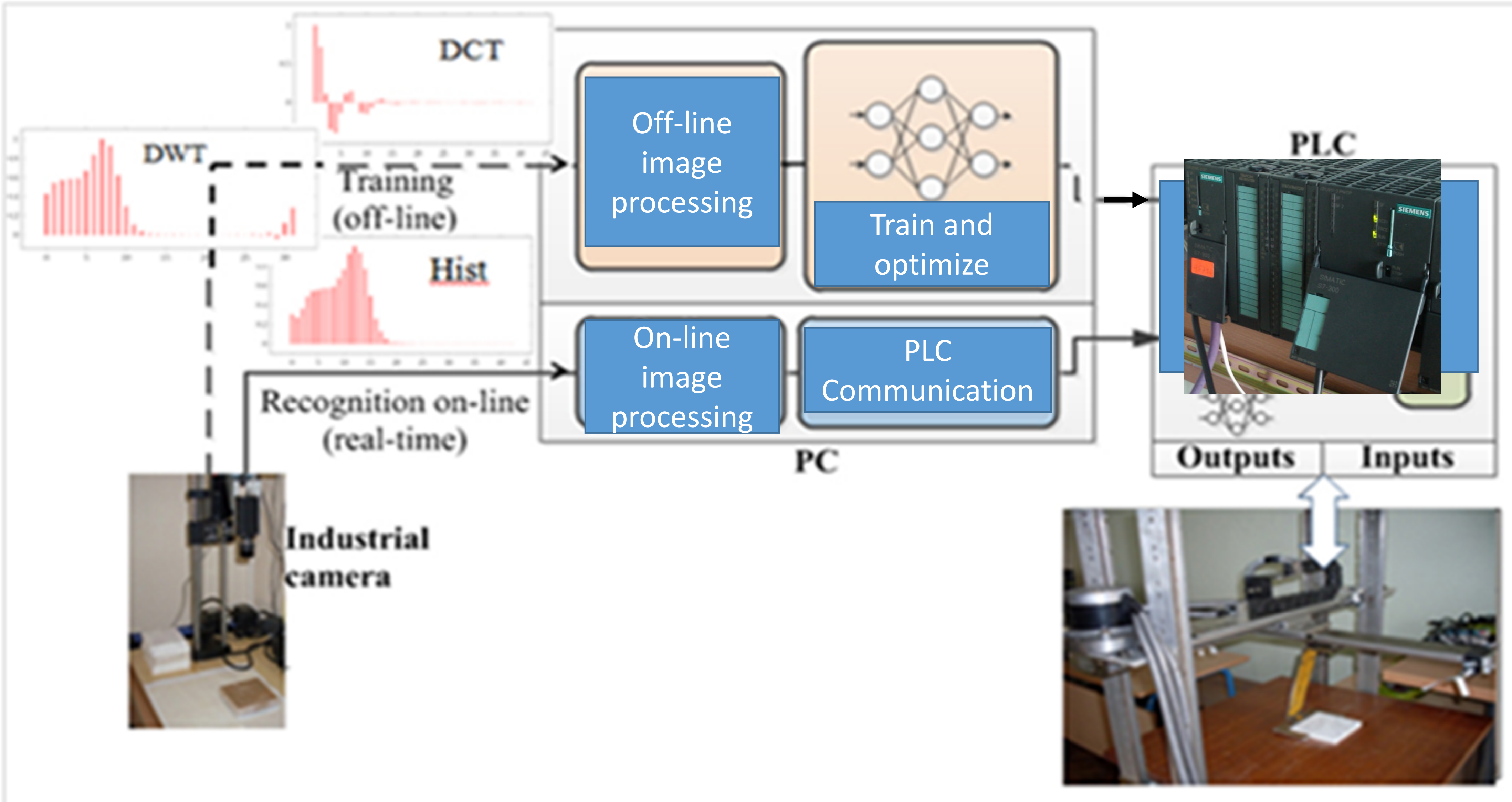




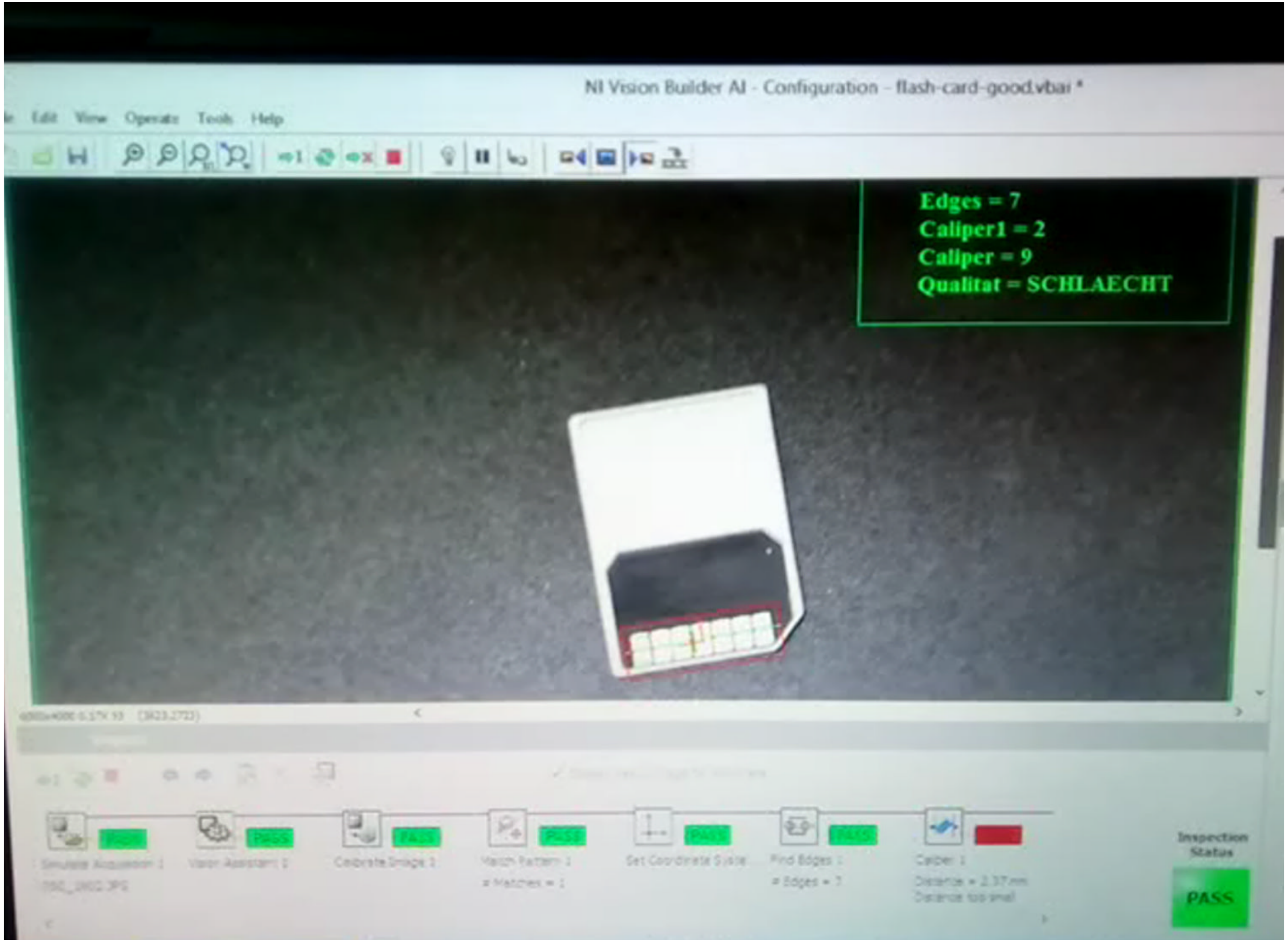
Complex structures of neural networks resembling human behaviour




Datasheet 4
Encoder 3
Kohonen 1
Datasheet 5
Encoder 4
Datasheet 1
Encoder 1
Encoder 2
Network
Datasheet 3
Datasheet 2
Encoder 1
Encoder 2
Kohonen Map
BPG MLP Network



DCT
DWT
Training
(off-line)
Hist
Off-line image processing
Train and optimize
PLC
On-line image processing
PLC Communication
Recognition on-line
(real-time)
PC
Outputs
Inputs
Industrial camera


NI Vision Builder AI - Configuration - flash-card-good.vbai *
Edit
View
Operate
Tools
Help
Edges = 7
Caliper1 = 2
Caliper = 9
Qualitat = SCHLAECHT
PASS
PASS
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PASS
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Inspection Status
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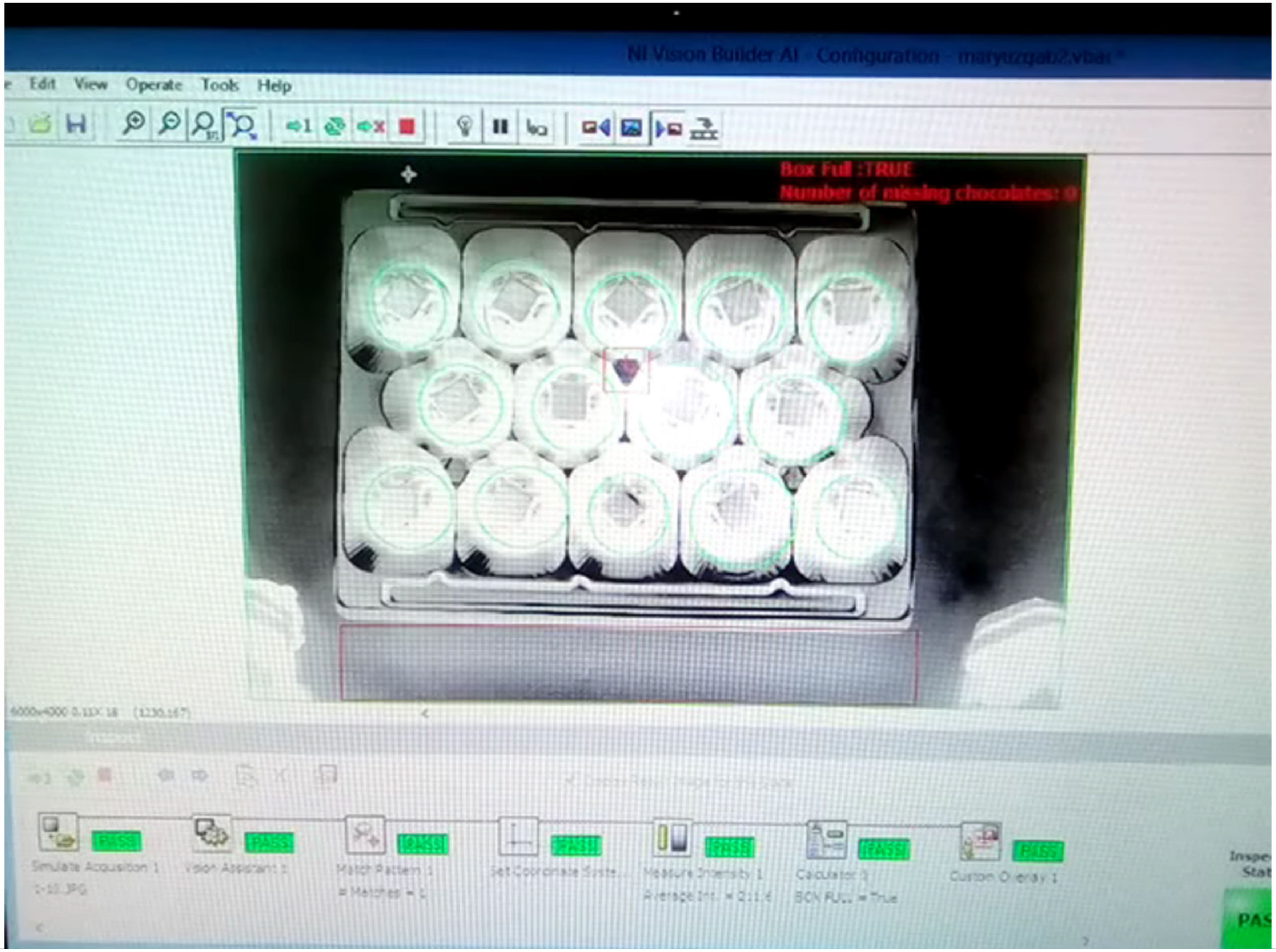
NI Vision Builder AI - Configuration
Edit
View
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Tools
Help
Box Full :TRUE
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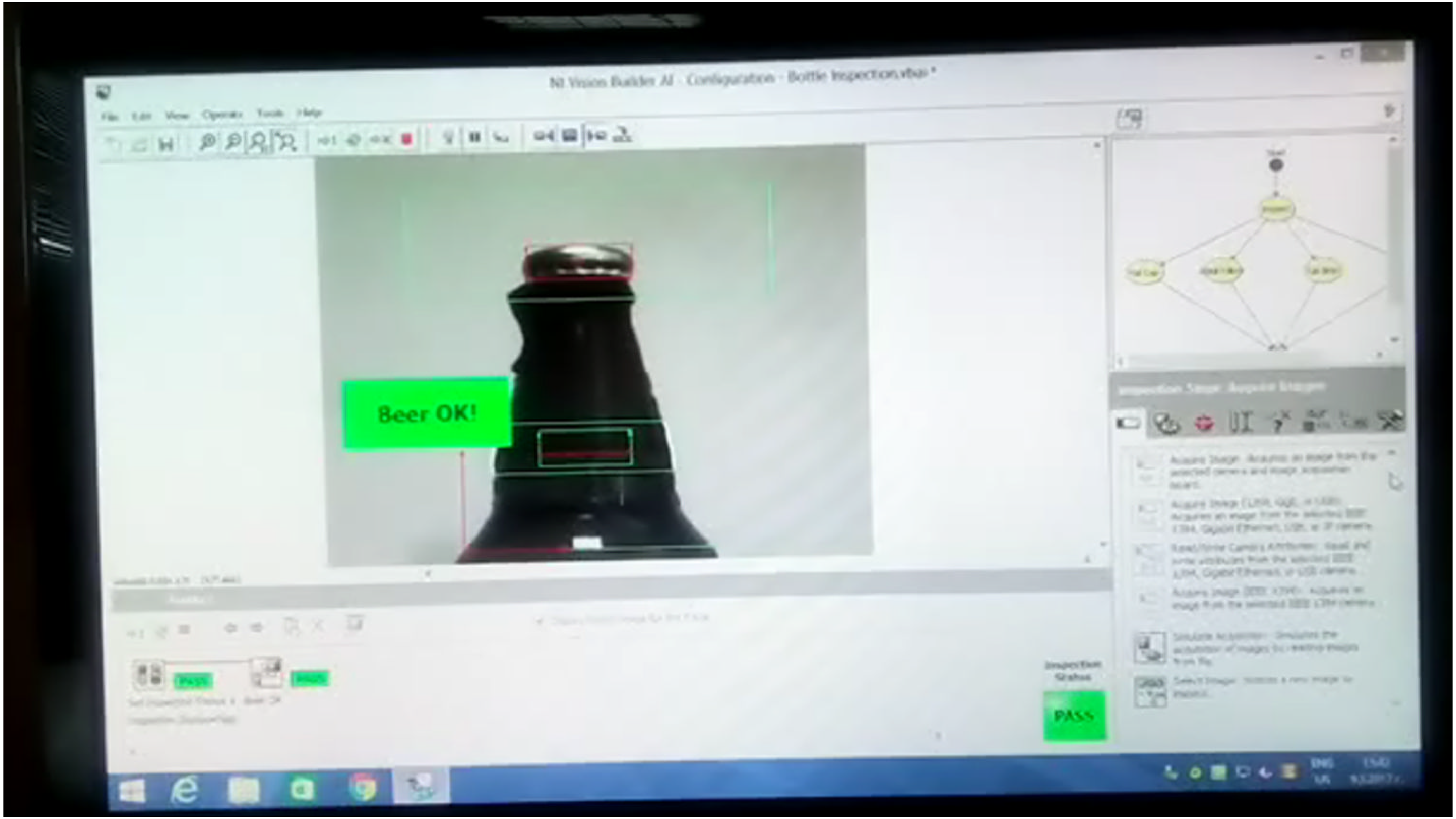
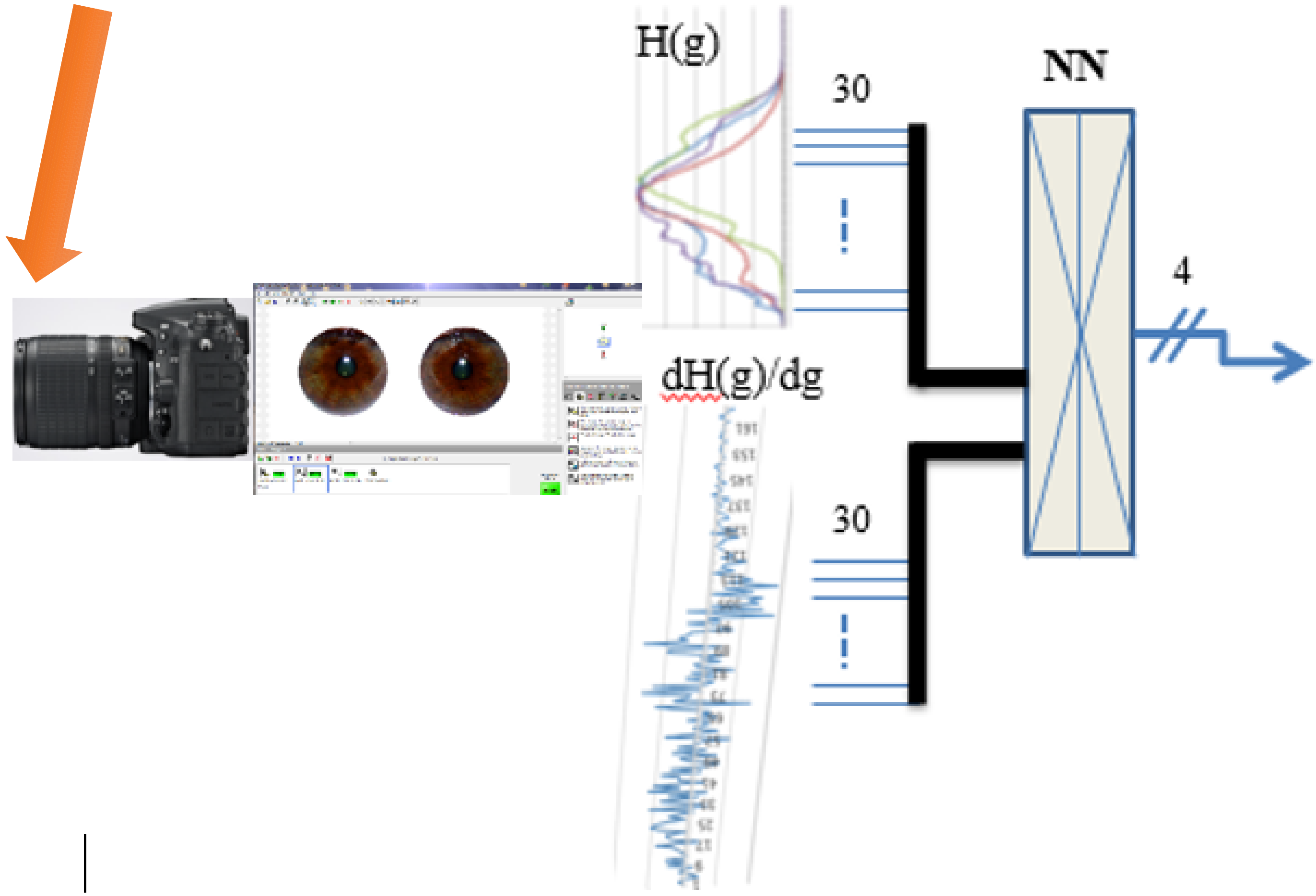
Simulate Acquisition 1
Vision Assistant 1
Match Pattern 1
Set Coordinate Syste...
Measure Intensity 1
Calculator 1
Custom Overlay 1


NI Vision Builder AI - Configuration - Bottle Inspection.vbai *
File Edit View Operate Tools Help
Beer OK!
PASS

- CCD Camera Nikon D7100,
- CMOS 23.5x15.6 sensor

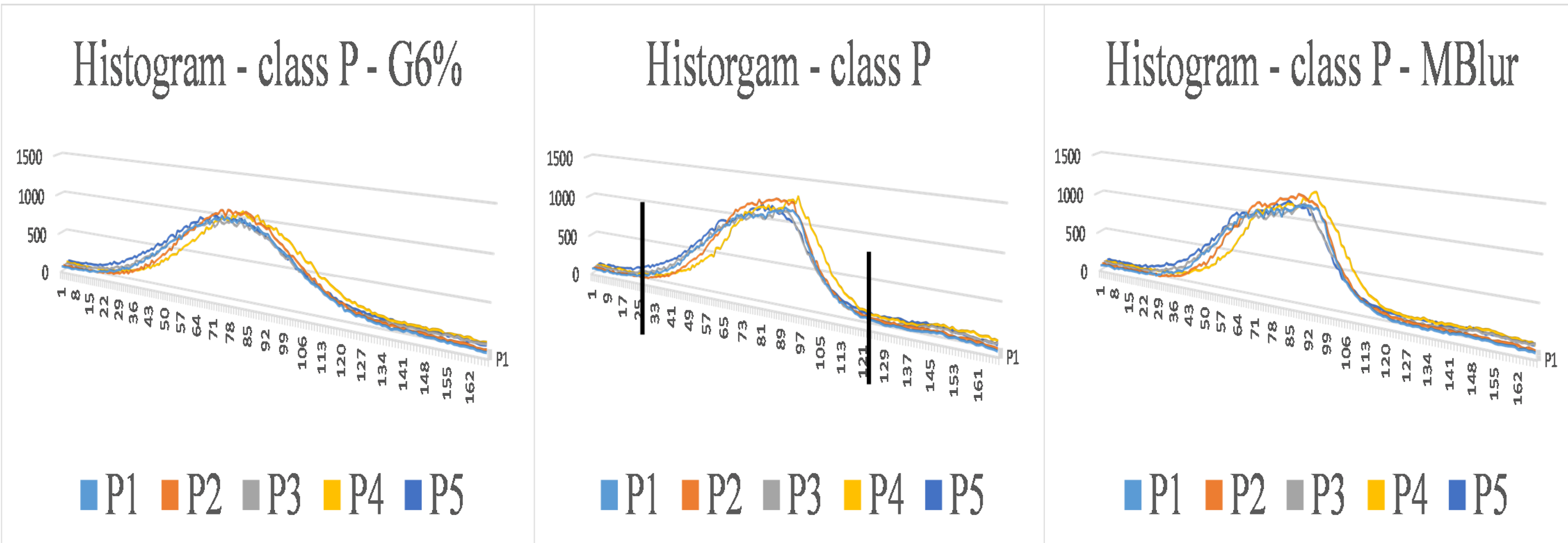
Resolution of 4494x3000 pixels.




Original Image
6% Gaussian Noise
10 Pixel Motion Blur
Person H
Person I
Person P
Person R

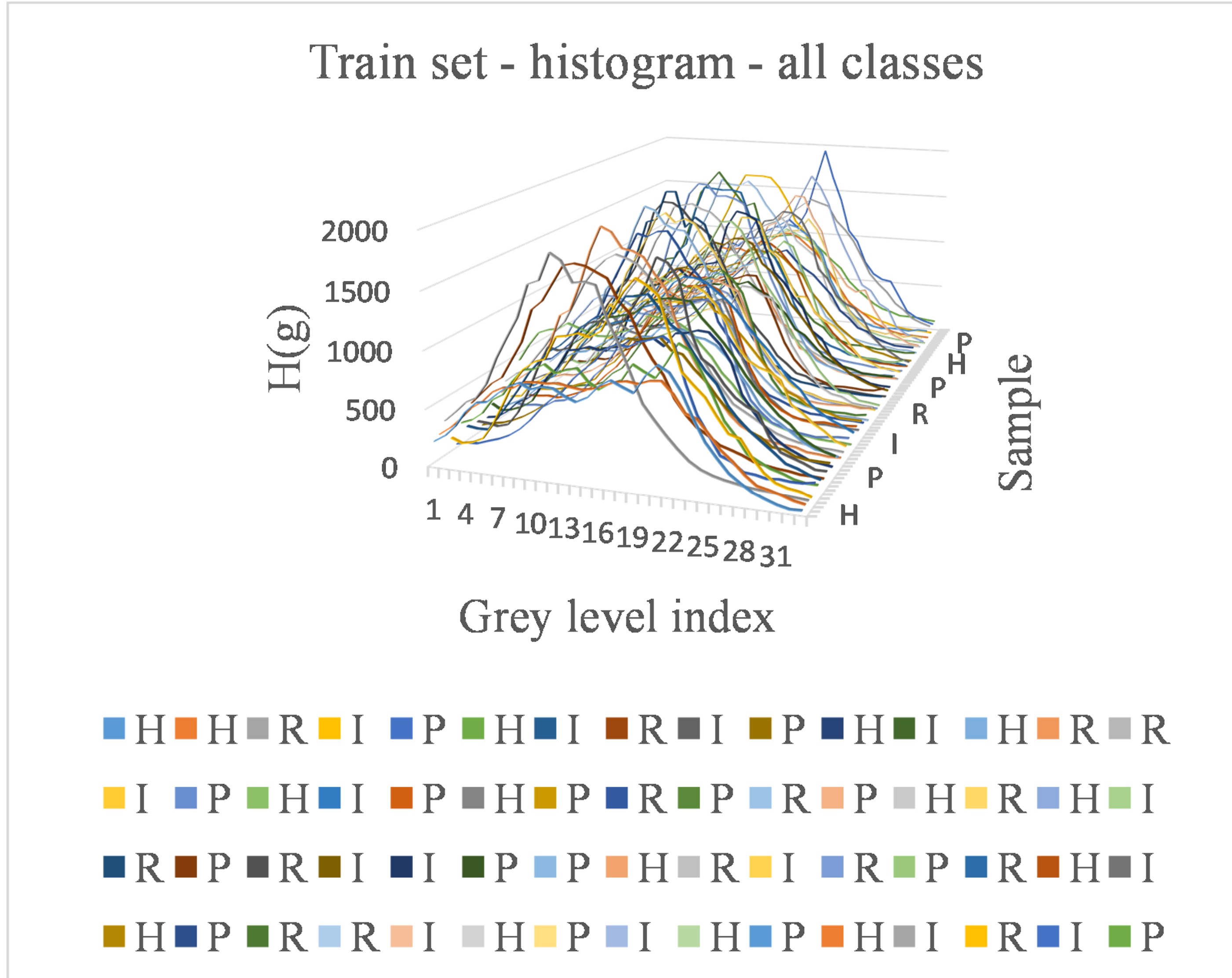
- $H(g) = [H_L(g) + H_R(g)]/2$
- $dH(g)/dg = [H(g_j) - H(g_i)]/(g_j - g_i)$

some emotional conditions cause blur



60 samples

60%-10%-30% (i.e. 36– train samples, 6 – validation, 18 – test samples



60 samples

60%-10%-30% (i.e. 36– train samples,

6 – verification samples, 18 – test samples

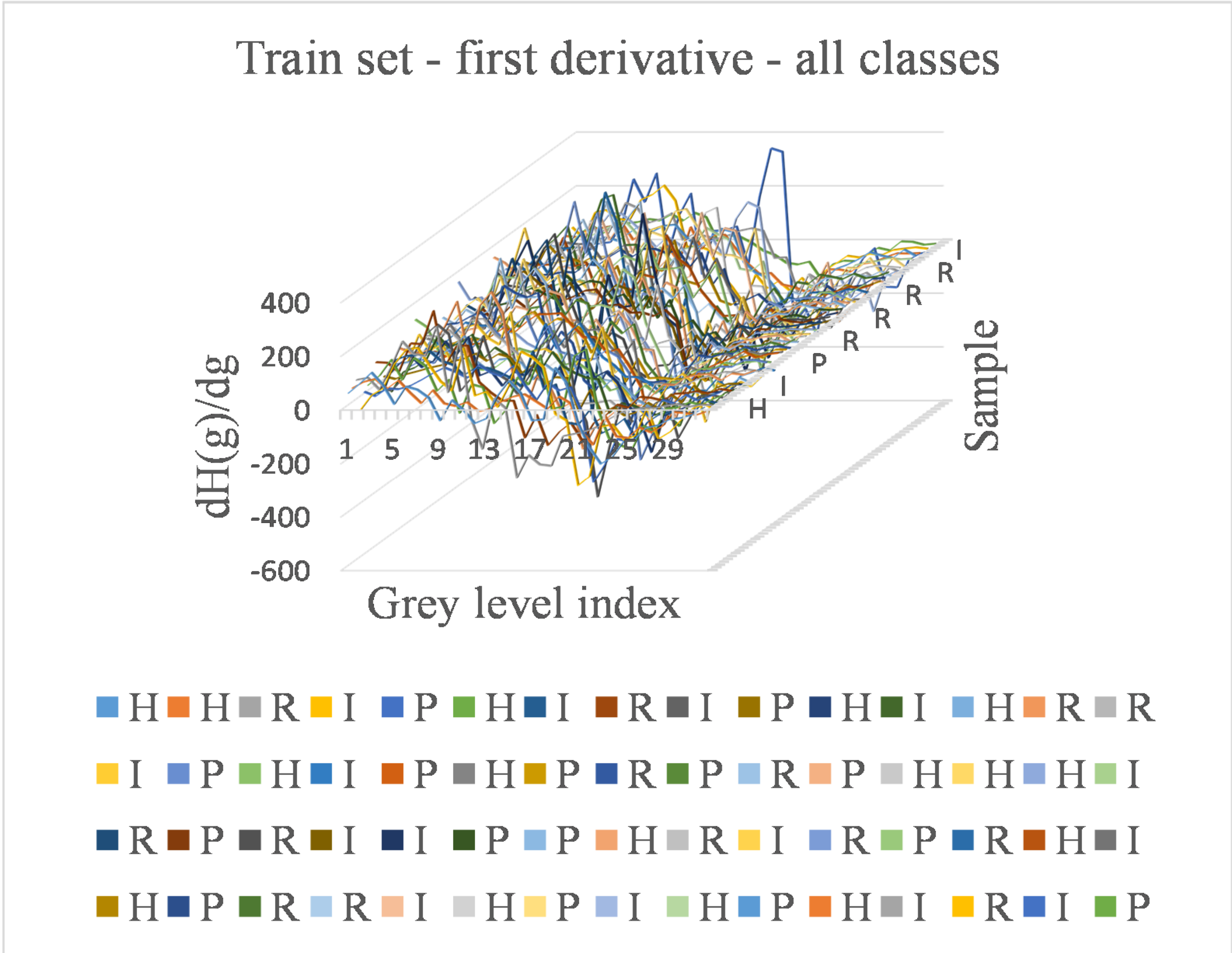
120 samples

Applying both: 72 – train samples,

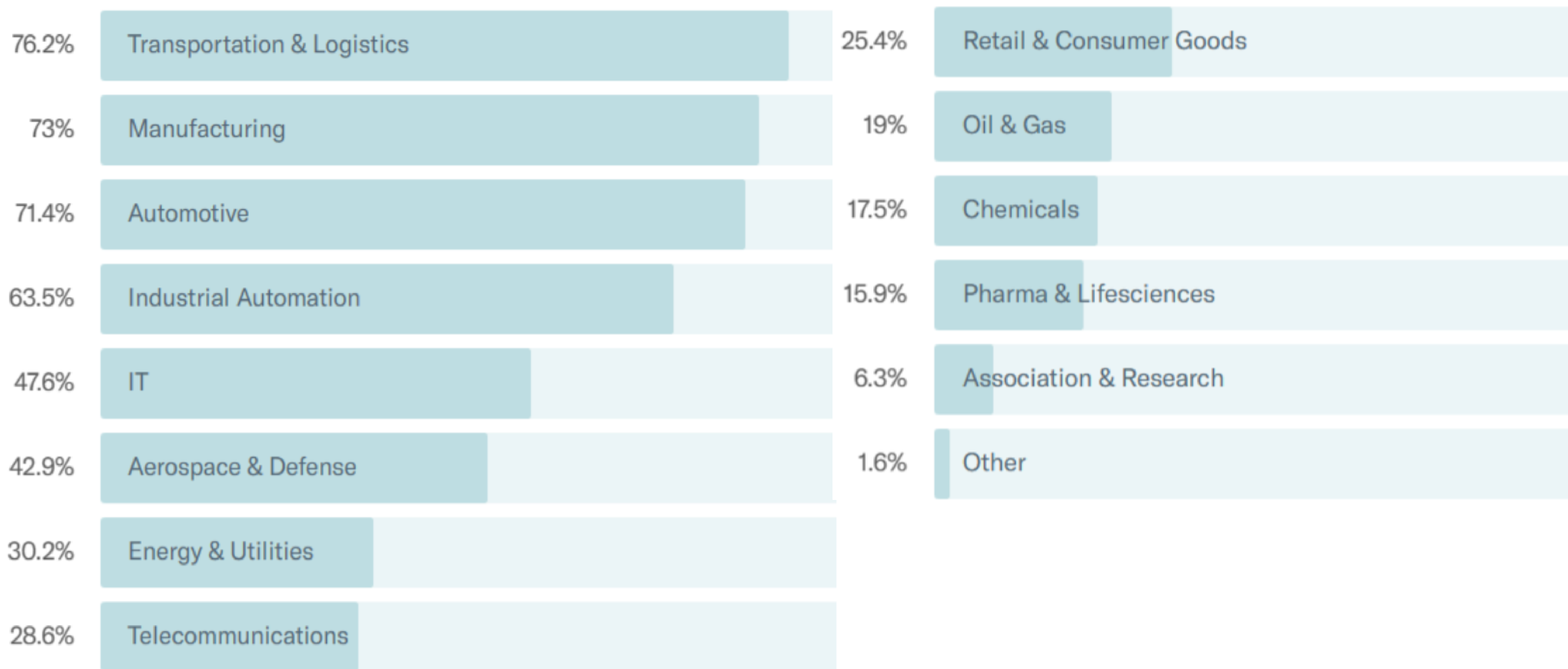
12 – verification samples,

36 – test samples

$dH_T(g)/dg$

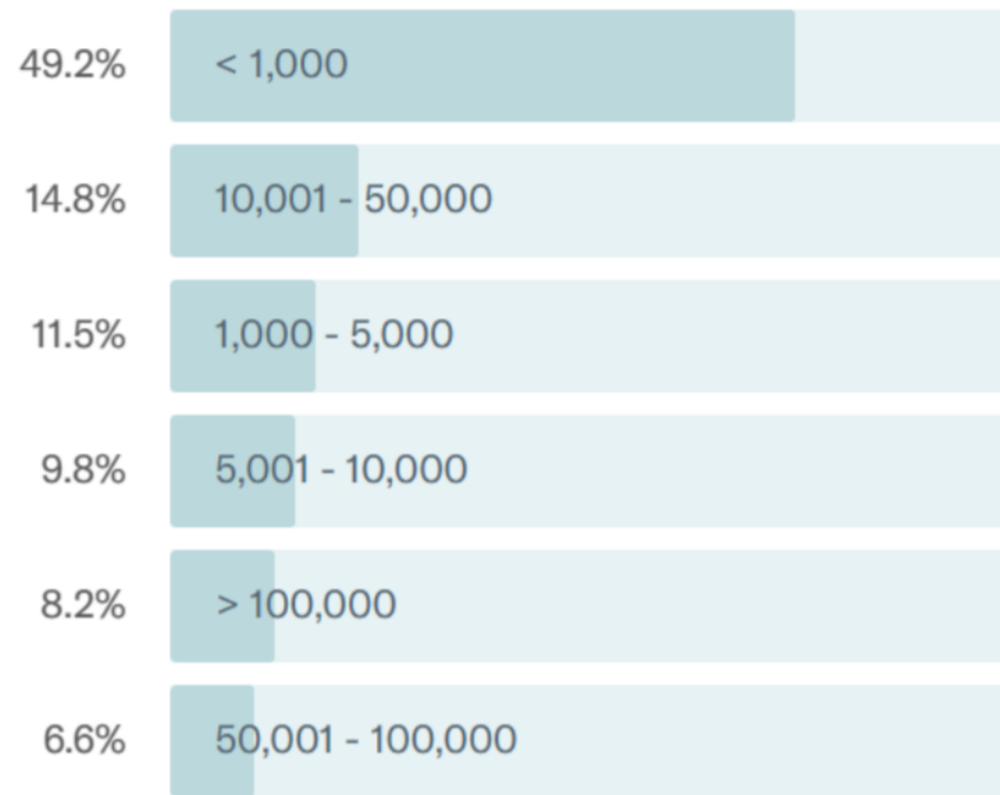


Industry Sectors affected by Cognition in Autonomous Systems

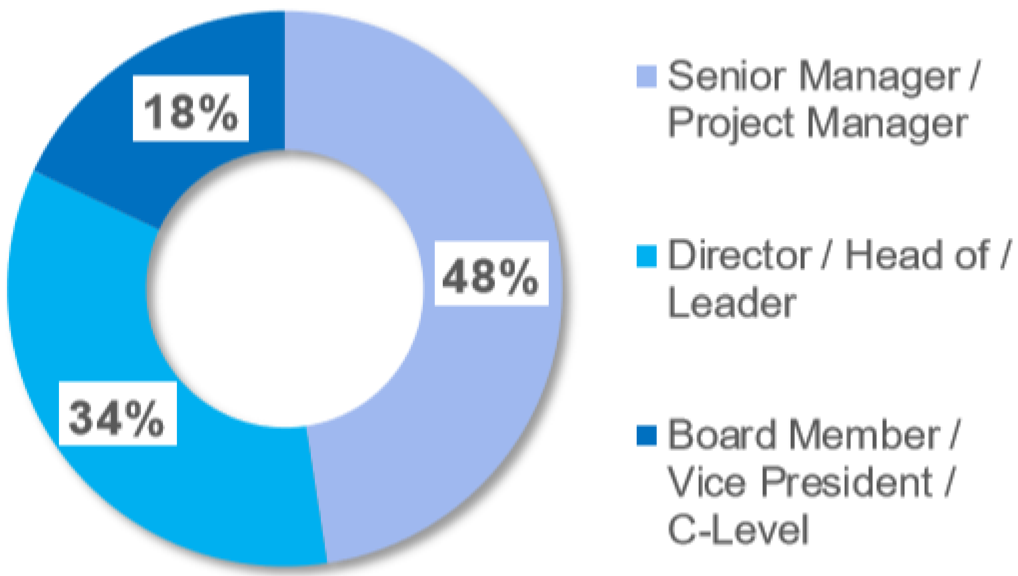


the company has made a survey

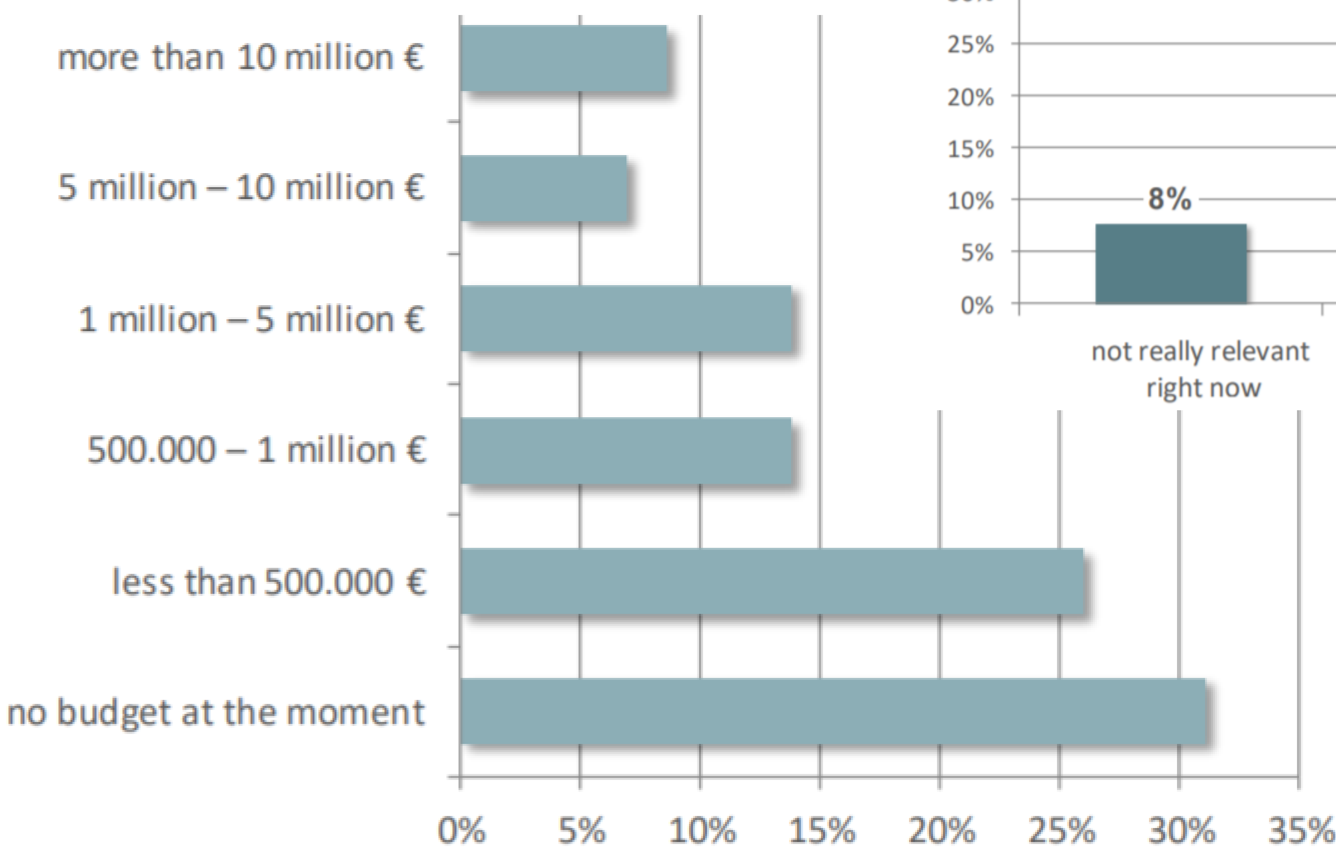
Company size by number of employees



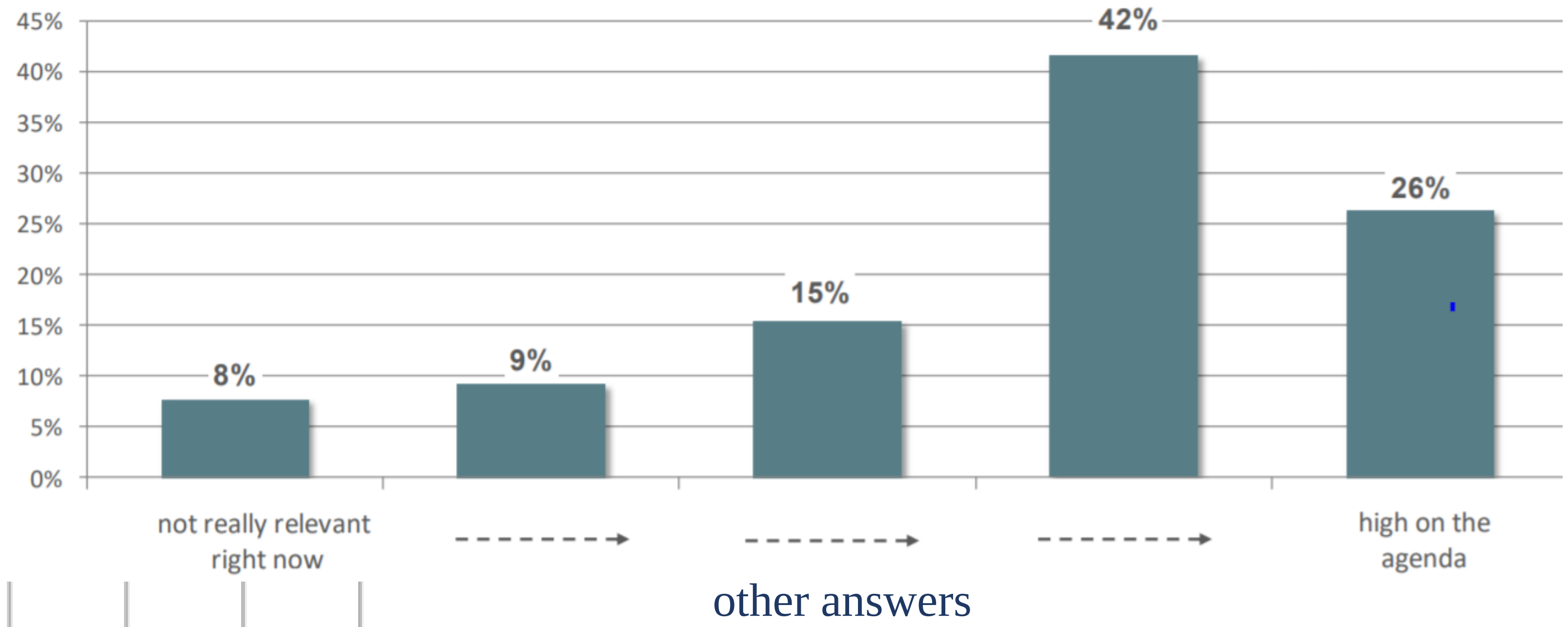
Survey Report - referred to 2018



Company’s budget spent on development of autonomous systems

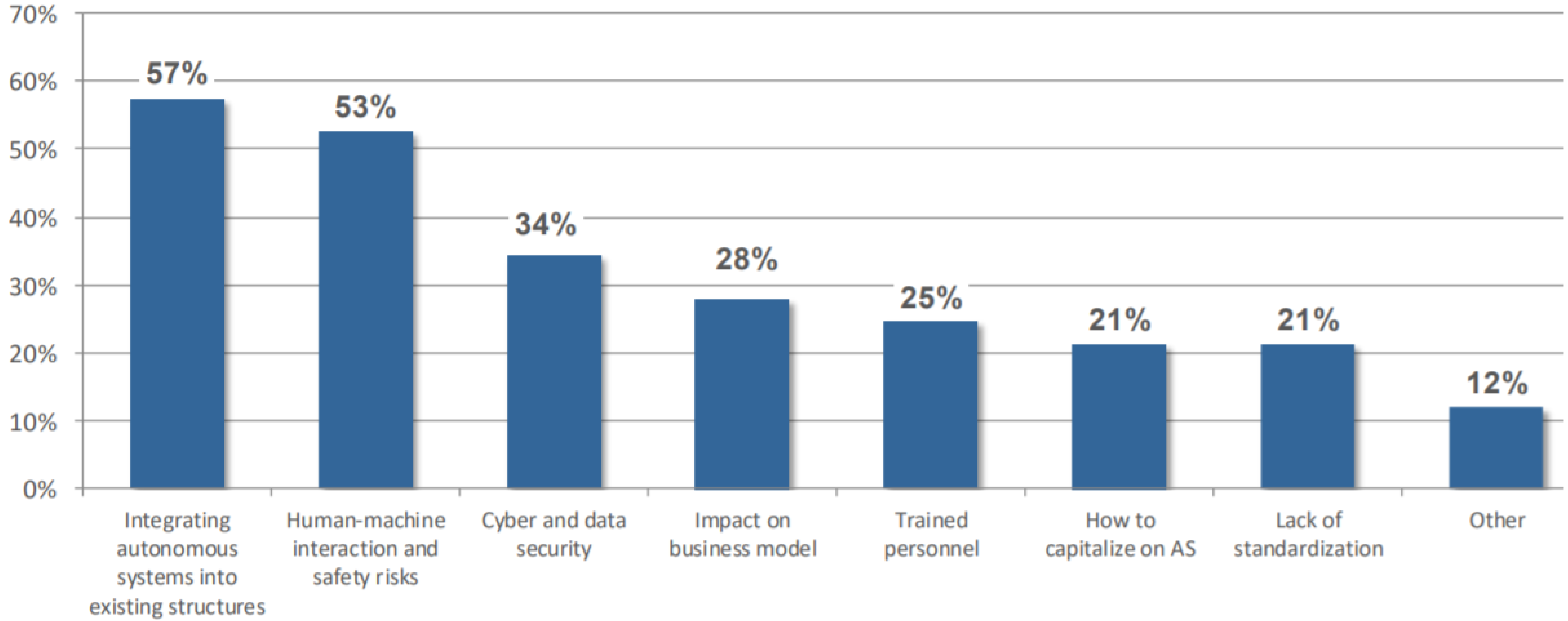


How high on your agenda and strategic outlook is the ***integration of cognitive machines and autonomous systems*** in your company?



Challenges of Autonomous Systems Integration

What are ***the biggest challenges*** the companies are facing in taking the first steps towards autonomous systems and cognition implementation?



Thanks for your attention !