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Seminar on measurement and data acquisition and 9th Balkan Open Competition In Software-designed Instrumentation

University of Belgrade, School of Electrical Engineering

Innovation center, University of Belgrade, School of Electrical Engineering

Center for the promotion of science

24th -28th of October 2019, Belgrade, Serbia

Erasmus+ KA2 strategic partnership Innovative Teaching Approaches in development of Software Designed Instrumentation and its application in real-time systems - ITASDI partners

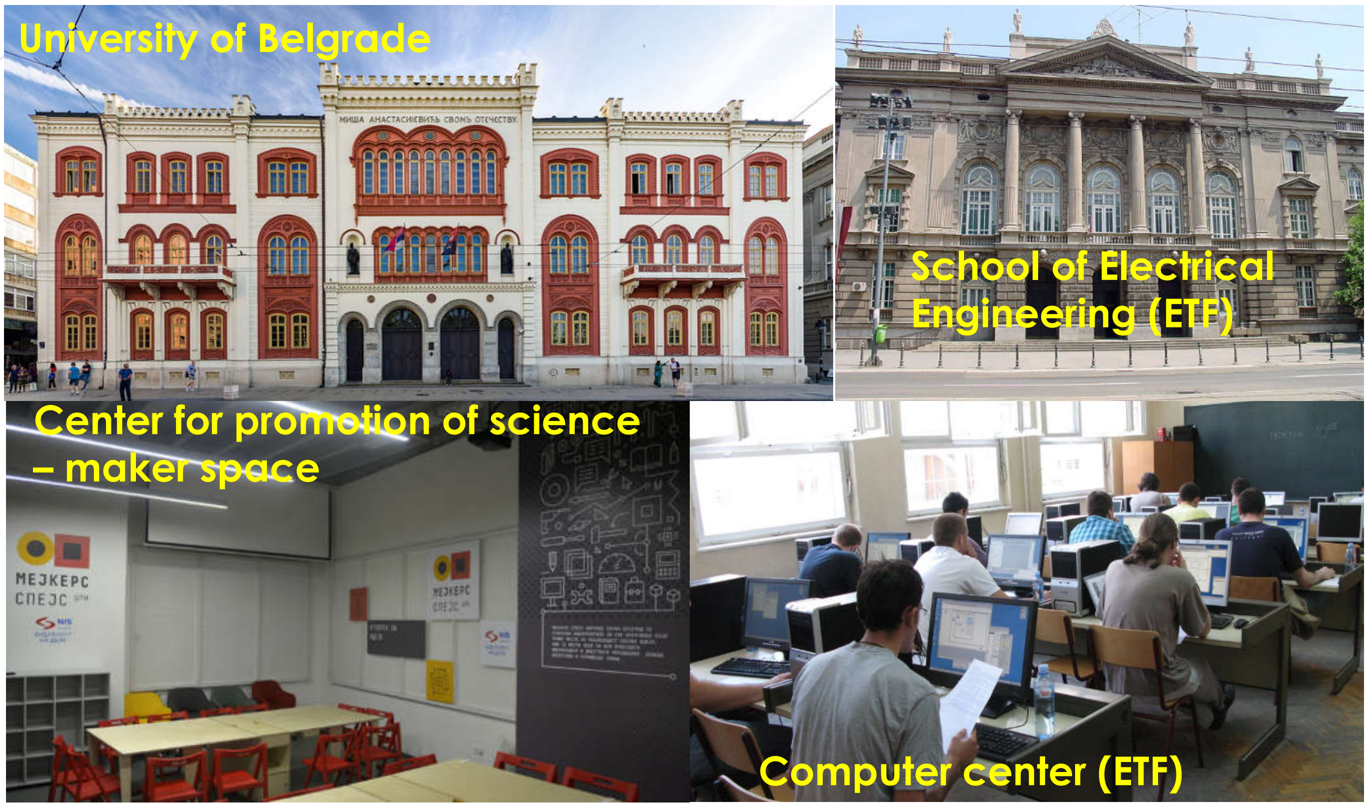
- Faculty of Technical Sciences, University of Novi Sad, Serbia - coordinator
- School of Electrical Engineering, University of Belgrade, Serbia
- Faculty of Electrical Engineering & Information Technologies, Skopje, Macedonia
- Tehničko veleučilište u Zagrebu, Zagreb University of Applied Sciences, Croatia
- Warsawa University of Technology, Faculty of Phisics, Poland

Project website: http://itasdi.uns.ac.rs/

Events

- 24th October **Precompetition activities**
  Computer Center, School of Electrical Engineering
- 25th October **Seminar on measurement and data acquisition**
  Ceremonial Hall of Belgrade University Rectorate
- 25-26th October **Hackathon (Lego and Arduino)**
  Center for the promotion of science
- 27th October **Individual Competition (LabVIEW)**
  Computer Center, School of Electrical Engineering
- 28th October **Postcompetition activities**
  Computer Center, School of Electrical Engineering

Events location



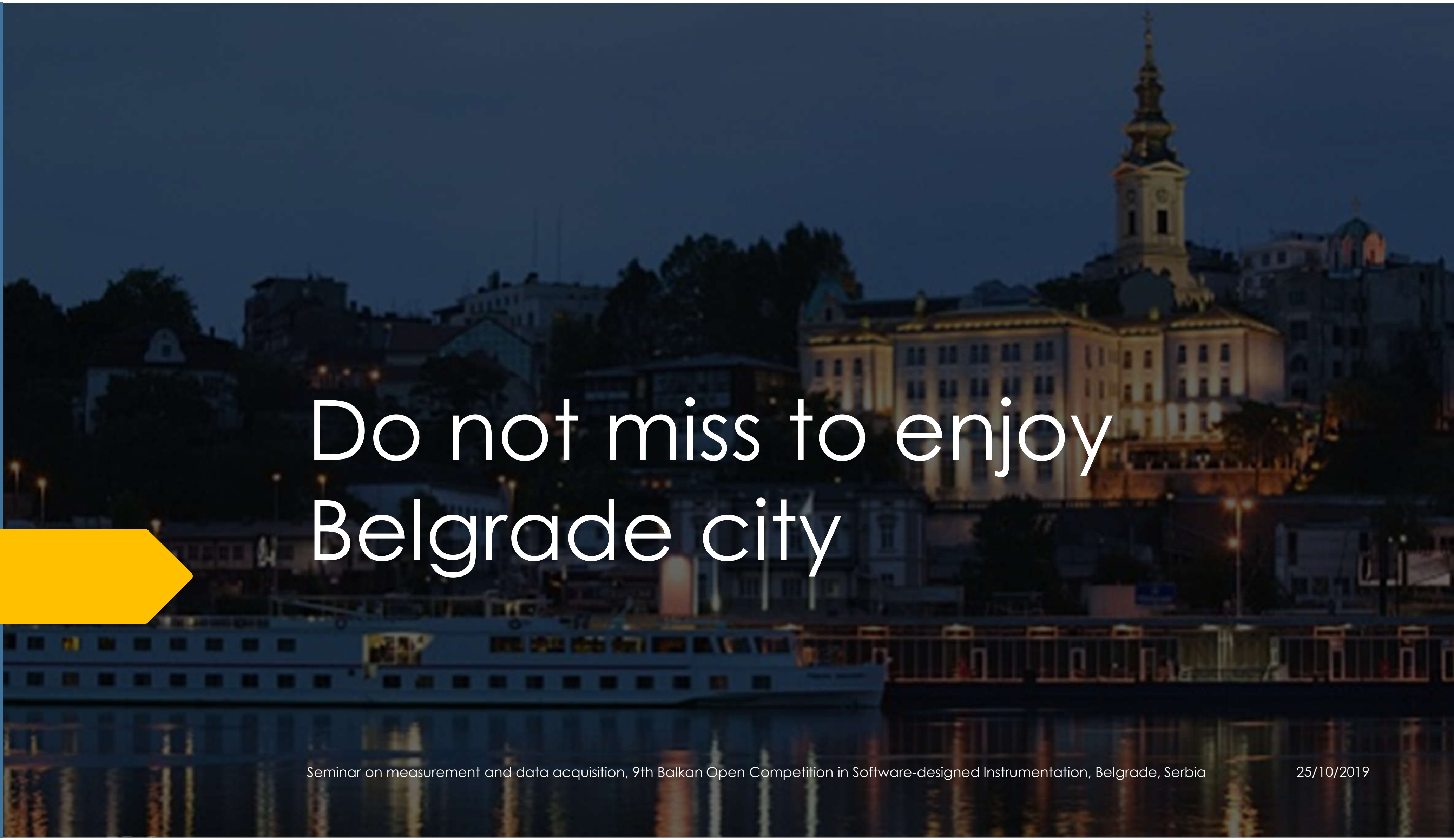
Registered participants

TOTAL: 87 participants

- 47 participants from non ITASDI Universities
  - 13 Industry representatives
  - 27 participants from other Serbian Universities, institutes or high schools
  - 7 foreign (non ITASDI) participants
- 40 participants from ITASDI Universities
- 18 foreign participants in total

Competitors

- 25 competitors for hackathon
- 20 competitors for individual competition



Do not miss to enjoy Belgrade city

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24th -28th of October 2019, Belgrade, Serbia

Milica Janković, Ass. Prof.

University of Belgrade – School of Electrical Engineering

Welcome

Day / Time	Event
Friday 25th	
09:00	Registration
10:00	"Welcome Speech"- opening of the *Seminar on measurement and data acquisition systems* University, faculty and project representatives
10:15	"Implementation of standards in metrology" Snežana Lilić, Institute of standardization of Serbia
10:35	"Software-designed vs. traditional instrumentation" Uglješa Jovanović, University of Niš – Faculty of Electronic Engineering

- Prof. Petar Marin, Vice-rector
- Prof. Milo Tomašević, Dean
- Academician Prof. Dejan Popović
- Ass. Prof. Boris Jakovljević - ITASDI coordinator

Implementation of standards in metrology

Snežana Lilić
Standardization manager
Institute for standardization of Serbia

Seminar on measurement and data acquisition 26 October 2019, Belgrade

ISS

ISS

Standardization

JUS ⟶ SRPS

Standardization

Standardization

Metrology

Metrology is the science of measurement, embracing both experimental and theoretical determinations at any level of uncertainty in any field of science and technology.

Measuring Unit

A unit of measurement is a definite magnitude of a quantity, defined and adopted by convention or by law, that is used as a standard for measurement of the same kind of quantity.

Base Quantity	Unit	Symbol
Length	meter	M
Mass	kilogram	Kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

ISS

Standards (Etalons)

A standard (or etalon) is an object, system, or experiment with a defined relationship to a unit of measurement of a physical quantity

Measuring Instruments

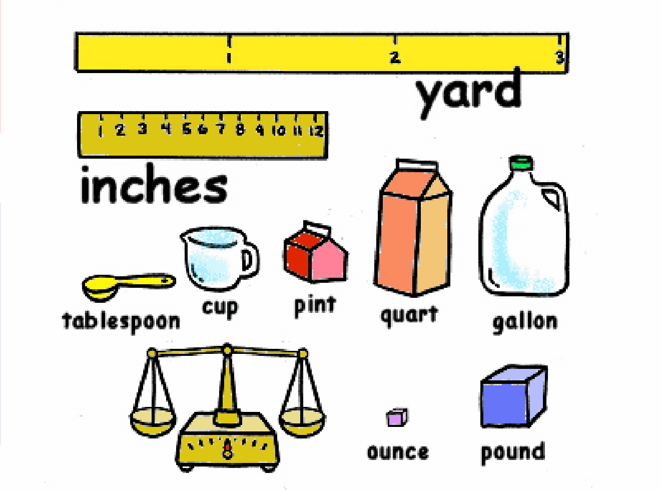
A measuring instrument is a device that (alone or in combination with one or more devices) is used for measurements.

Calibration

Calibration is operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties (of the calibrated instrument or secondary standard) and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

Measurement

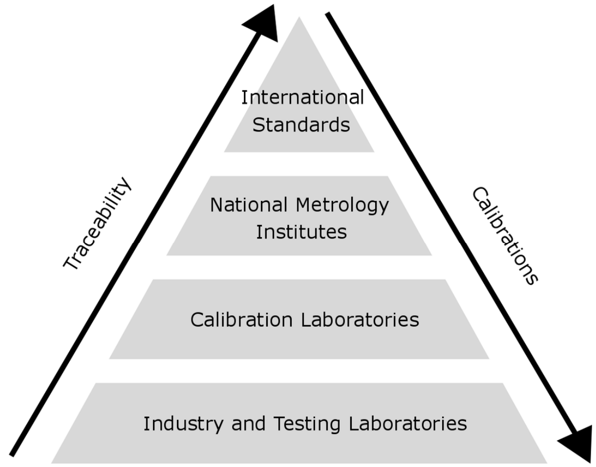
Measurement is the assignment of a number to a characteristic of an object or event, which can be compared with other objects or events.
Measurement is the action of measuring something.



ISS

Traceability

Metrological traceability is defined as the "property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty".



DMDM

DMDM - Directorate of Measures and Precious Metals
OIML - Organization of Legal Metrology

Some national laboratories:

- ✓ for dimensional metrology
- ✓ for acoustics
- ✓ for mass
- ✓ for pressure
- ✓ for liquid volume
- ✓ for gas volume
- ✓ for time and frequency and time distribution
- ✓ for direct current voltage and direct current
- ✓ for temperatures
- ✓ relative humidity and heat
- ✓ for precious metals…

Directives

- **NAWI Directive 2014/31/EU, Directive for non-automatic weighing instruments** (sets down the essential requirements for weighing instruments such as retail scales, industrial scales and weighbridges)

- **MID Directive 2014/32/EU, Measuring instruments Directive** (covers these measuring instruments: water meters, gas meters and volume conversion devices, active electrical energy meters, heat meters, measuring systems for the continuous and dynamic measurement of quantities of liquids other than water, automatic weighing instruments, taximeters, material measures, dimensioning systems, exhaust gas analysers)

List of Serbian standards in the field of measuring instruments

SRPS EN 1359:2011 - Gas meters - Diaphragm gas meters
SRPS EN 1434-1:2011 - Thermal energy meters - Part 1: General requirements
SRPS EN 1434-2:2011 - Thermal energy meters - Part 2: Constructional requirements
SRPS EN 1434-4:2011 - Thermal energy meters - Part 4: Pattern approval tests
SRPS EN 12261:2011 – Gas meters - Turbine gas meters
SRPS EN 12405-1:2011 - Gas meters - Conversion devices - Part 1: Volume conversion
...

M115 Hydraulic machinery and cryogenic techniques
CEN/TC 237 Gas meters
CEN/TC 176 Thermal energy meters
CEN/TC 92 Water meters

List of Serbian standards in the field of measuring instruments

SRPS EN 50470 - Electricity metering equipment (a.c.) (3 standards)
SRPS EN 62058 - Electricity metering equipment (a.c.) - Acceptance inspection (3 standards)
SRPS EN 62059-32-1:2013 - Electricity metering equipment - Dependability - Part 32-1: Durability - Testing of the stability of metrological characteristics by applying elevated temperature (scope - specifies a method for testing the stability of metrological characteristics of electricity meters, by operating a test specimen at the upper limit of the specified operating range of temperature, voltage and current for an extended period)

N013 System aspects of electrical energy supply, electrical energy measurement and load control
CLC/TC 13 Electrical energy measurement and control

Measurement for quality improvement

Relevant standards

- ✓ SRPS ISO/IEC 17025:2017 - General requirements for the competence of testing and calibration laboratories
- ✓ SRPS ISO/IEC 17020:2012 - Conformity assessment - Requirements for the operation of various types of bodies performing inspection
- ✓ SPRS EN ISO/IEC 17065:2016 - Conformity assessment - Requirements for bodies certifying products, processes and services

also…

- ✓ SRPS ISO 9001:2015 – Quality management systems – Requirements
- ✓ SRPS ISO 14001:2015 - Environmental management systems - Requirements with guidance for use
- ✓ SRPS ISO 10012:2007 – Measurement management systems - Requirements for measurement processes and measuring equipment

Thank You for Your Attention!

www.iss.rs

snezana.lilic@iss.rs

University of Niš, Faculty of Electronic Engineering in Niš

Software-designed vs. traditional instrumentation

Dr. Uglješa Jovanović

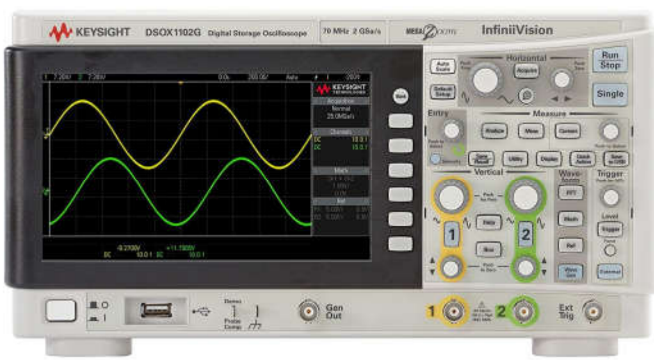
Belgrade, 25.10.2019

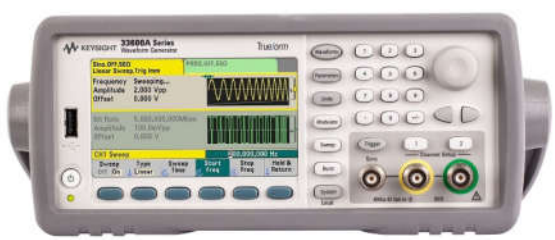
Instruments

- An instrument is a device designed to collect data from an environment or a system under test and to display information on the acquired data.
- It is designed to perform one or more specific tasks defined by a vendor.
- There are two types of instruments:
  - Analogue,
  - Digital.
- A measurement system includes several instruments with additional equipment designed to perform one or more measurements.

Instruments

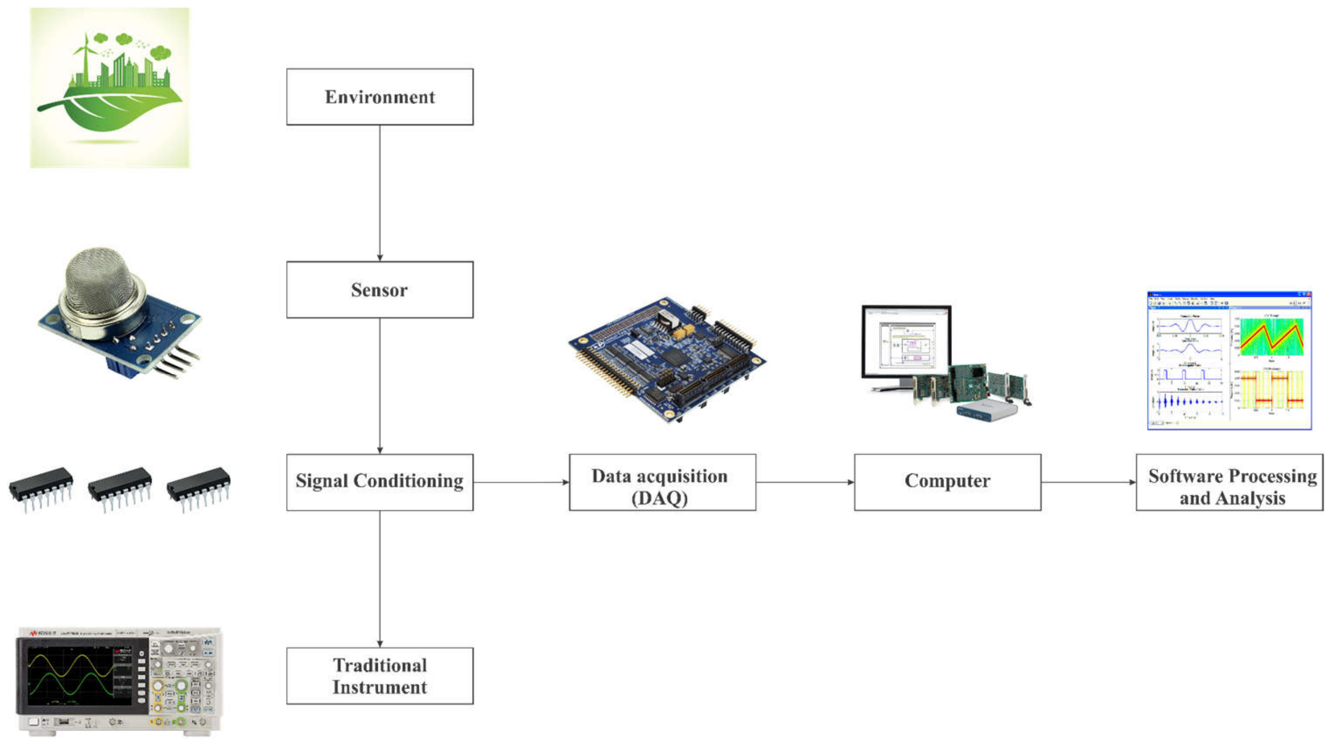
- The rapid adoption of the PC in the last 20 years launched a revolution in measurement instrumentation.
- Ongoing shift from traditional hardware-based instrumentation systems to software-based systems that exploit the computing power, productivity, display, and connectivity capabilities of computers.
- Traditional instruments are scope, function generator, multimeter…





Block diagram of instrument

- The first two stages (sensor and signal conditioning) are shared by both techniques.



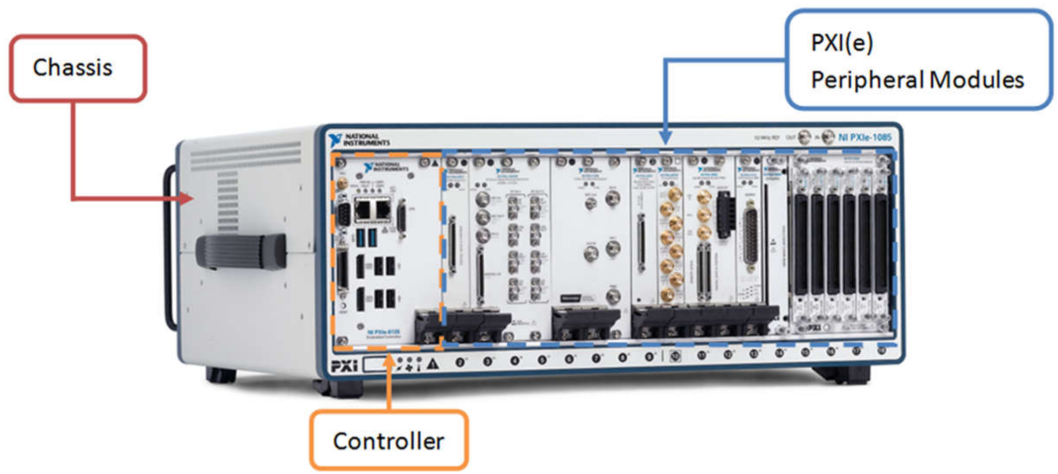
Benefits of software Instrumentation

- Enables integration of different types of instruments into a single instrument - a PC.
- Provides easy instrument programming, reprogramming and upgrade of existing instruments.
- Allows utilization of existing PC resources: memory space, fast processing of big data, databases, Internet, e-mail, LAN...
- The use of instruments is made easier as they are based on the PC user interface.
- Reusability.

Applications of software instruments

- Simulation,
- Prototyping,
- Signal processing,
- Measurement,
- Remote measurement,
- Control.

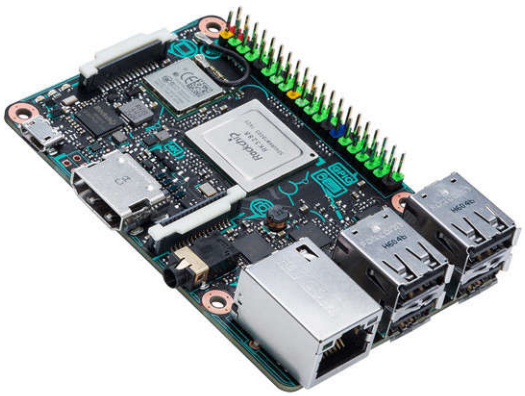
Data acquisition hardware

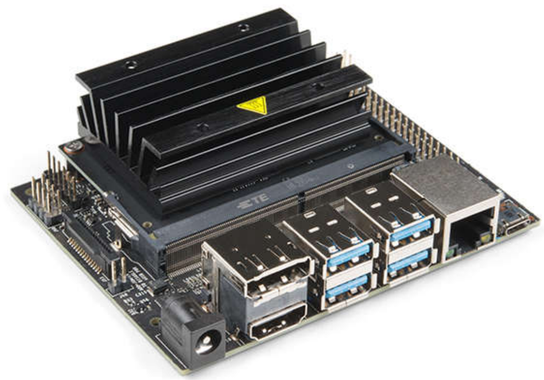


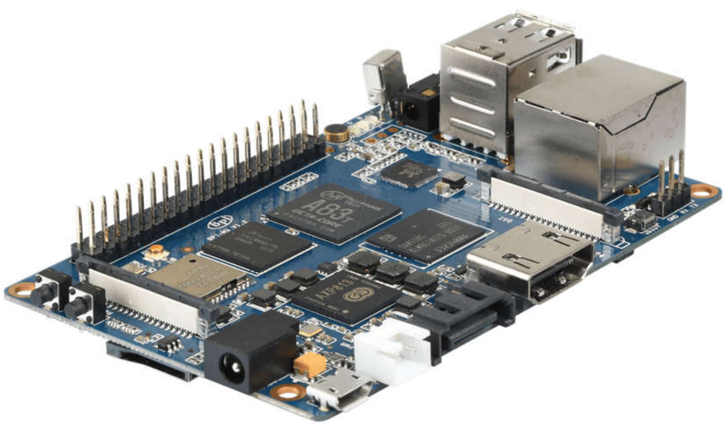
Commonly used software

- Classic program languages.
- Specialized graphical languages – NI LabVIEW, Keysight VEE (parallel execution, code according to block diagram).

Single board computers

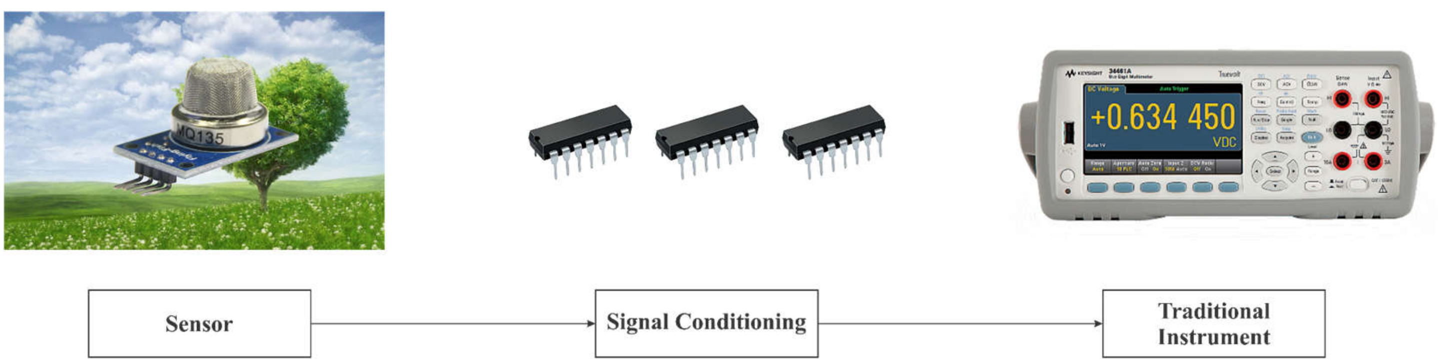






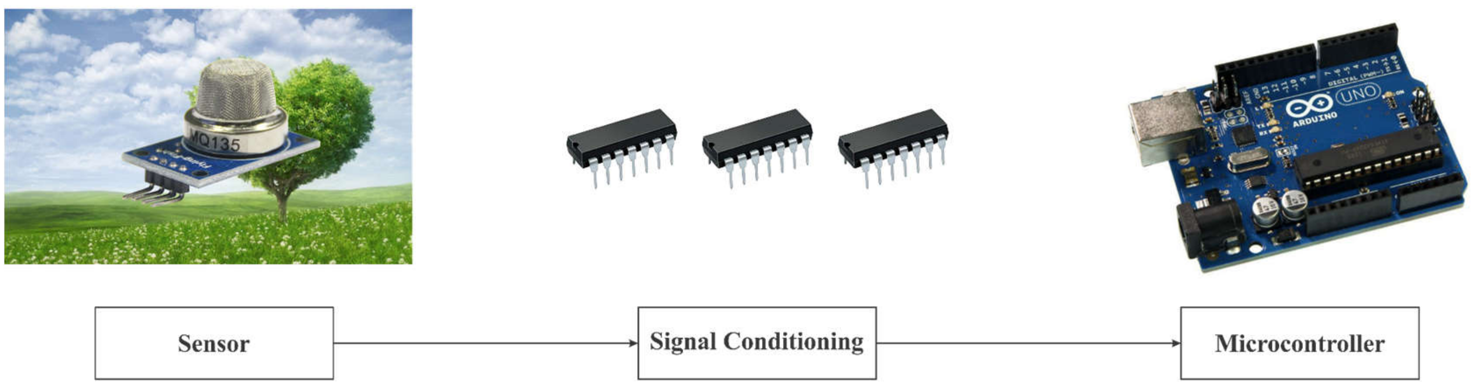
Instrumentation development

- With traditional instrumentation.
- With software instrumentation.



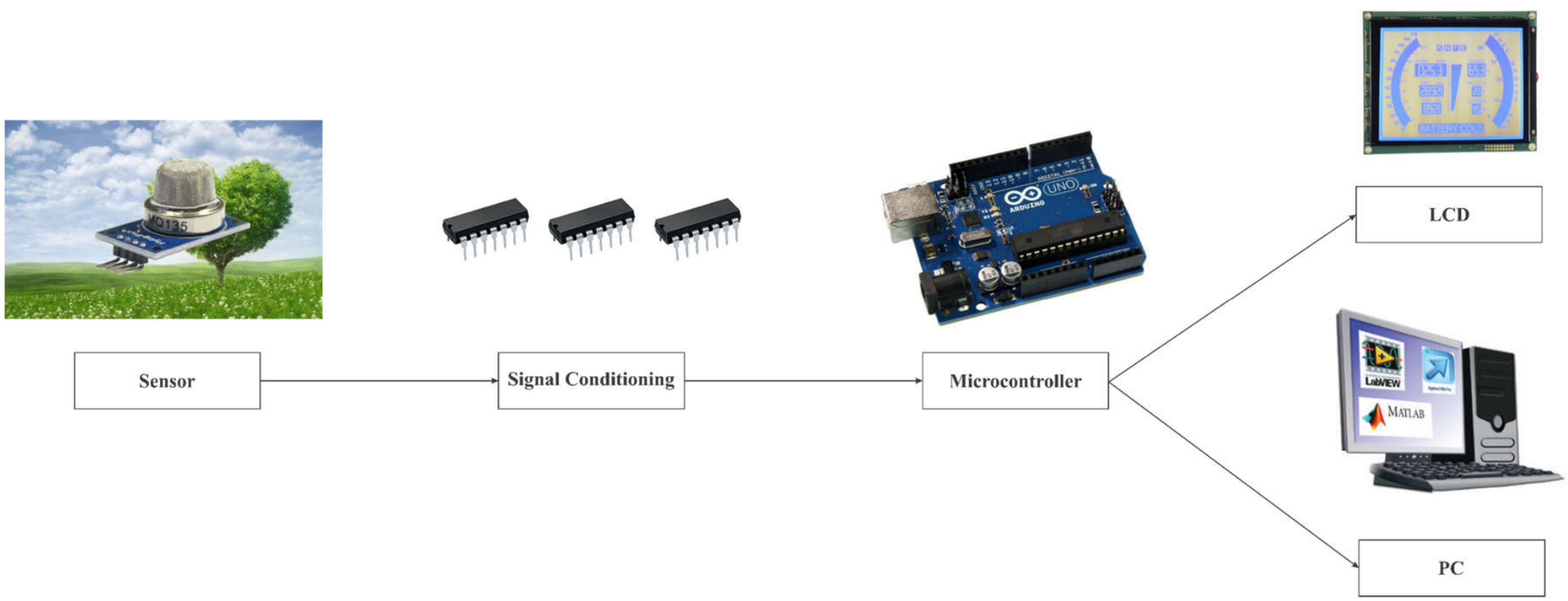
Instrumentation development

- In order to have the best possible accuracy it is necessary to perform analogue to digital conversion rather than transmitting analogue signal over long distances, especially in industrial conditions.



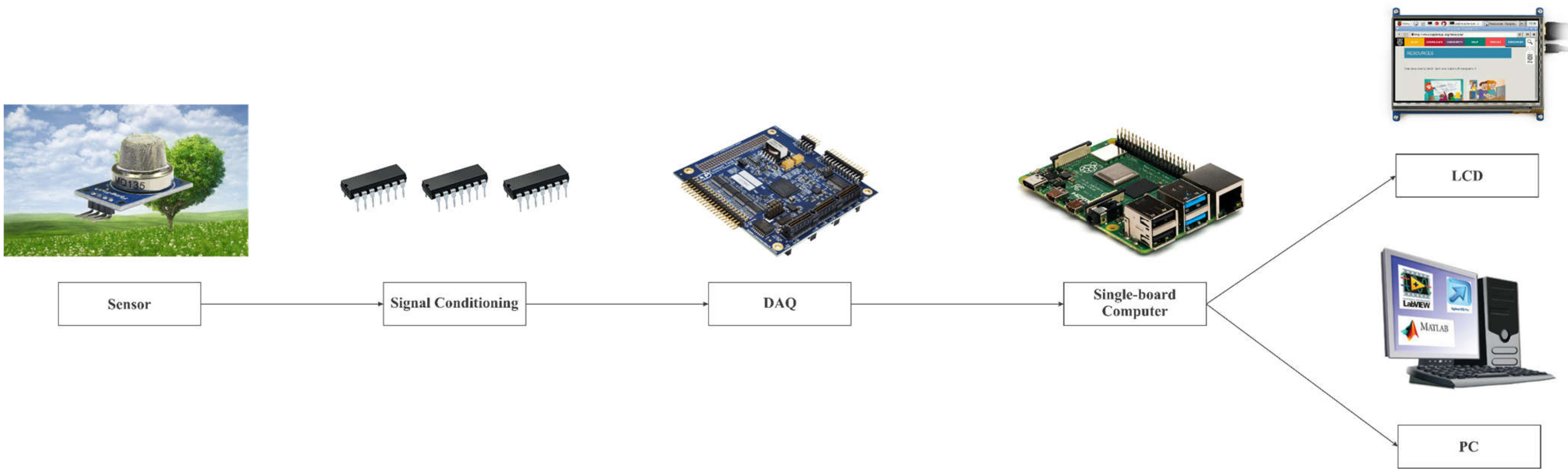
Instrumentation development

- Traditional instrumentation - Microcontroller is final device.
- Software instrumentation – Microcontroller forwards signal to PC.



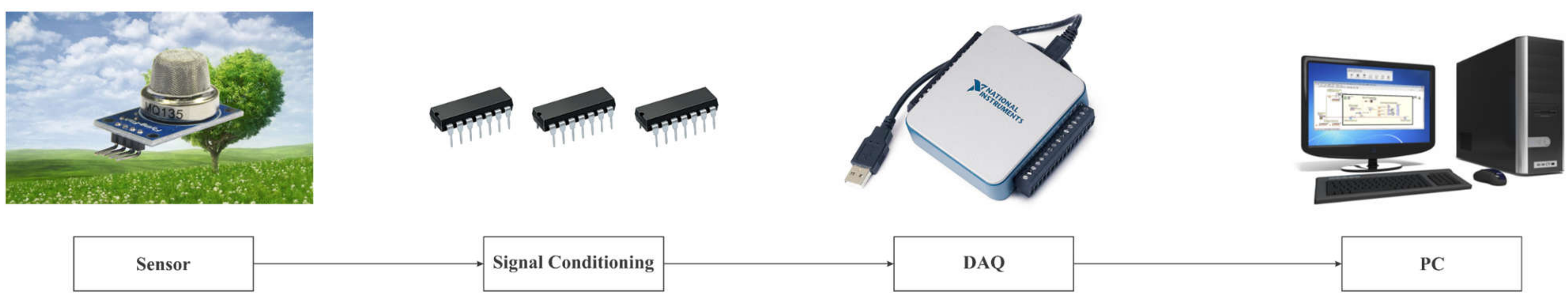
Instrumentation development

- Low-cost software instrumentation based on single board computer.
- Designer must avoid overkill of this type of implementation as oppose to microcontroller.



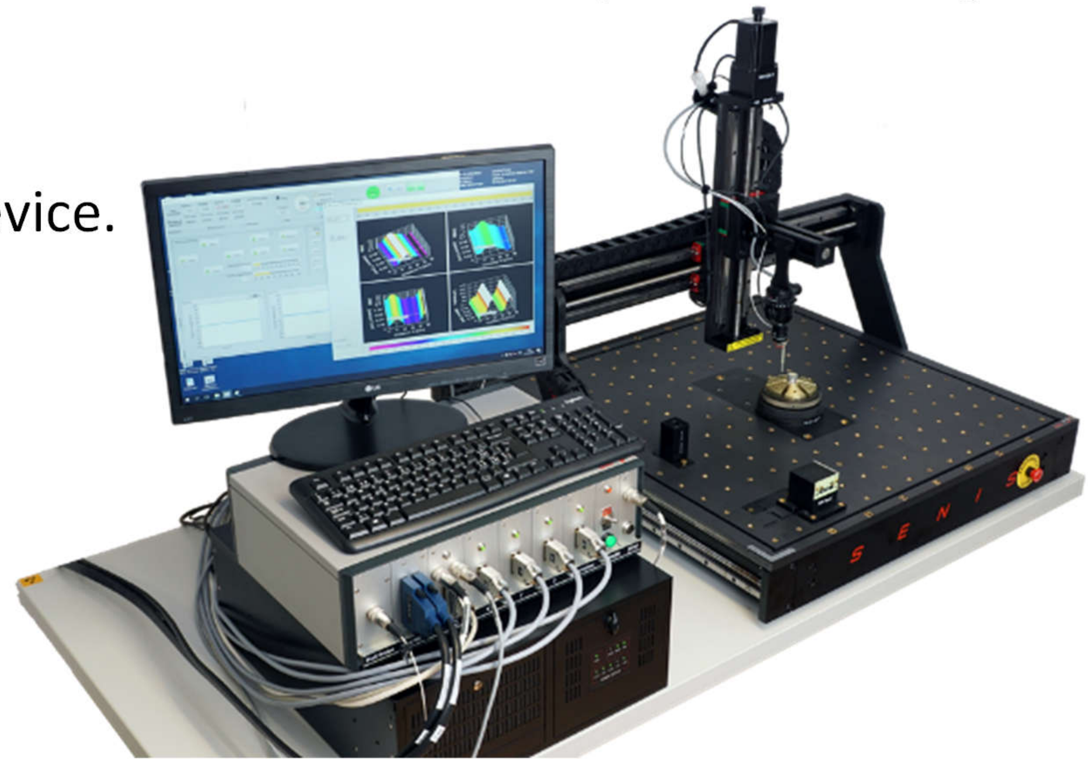
Instrumentation development

- More powerful PC based software instrumentation.
- The gap between PC based and single board based software instrumentation is narrowing.



Combined techniques

- Graphical user interface is built on MS Windows platform using NI LabVIEW.
- Highly accurate 3D teslameter.
- PCI-7354 Motion Controller Device.
- NI PCle-6321/NI 6212 DAQ.



Differences between both techniques

Traditional instrument	Software instrument
Functions defined by vendor	Functions defined by user
Pre-defined hardware components	User-defined measurement system
Closed architecture, limited connectivity	Open architecture, various connectivity options
Limited storage capacity	Unlimited storage capacity
Usually have small display screen	PC monitors have much better color depth and pixel resolution
Complex and expensive hardware	Complex hardware functionality implemented on software
Recalibration is required	Recalibration is not required
Bulky and stimulus specific	Compact and portable
High maintenance costs	Software minimizes maintenance costs
Better solution for simple operations	Better solution for complex operations

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"University of Belgrade – Outputs of the ITASDI project"

Milica Janković, Ass. Prof.

Research group for Biomedical Instrumentation and Technologies (BMIT)

University of Belgrade – School of Electrical Engineering

http://bmit.etf.bg.ac.rs/

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UB ITASDI outputs

"Seminar on measurement and data acquisition" is intended for all participants and stakeholders to promote the following intellectual outputs:

- modified courses in Bachelor studies in Computer Engineering
  - Theory of Robotics System
  - Practicum of Measurement and Data Acquisition systems
- new book "Practicum of Measurement and Data Acquisition Systems".

Theory of Robotics System

- New lectures with code examples
  1. "Introduction to the course“
  2. "Introduction to ROS“
  3. "Development of mobile robots and concepts of work“
  4. "Locomotion of mobile robots“
  5. "Kinematics of mobile robots“
  6. "Kinematic robot control with differential drive“
  7. "Dinamics and kinematics of robots with differential drive"

Theory of Robotics System

- New lectures with code examples
  8. "Perception | Sensors“
  9. "Perception | Line Fitting“
  10. "Localization“
  11. "Localization - Kalman Filter“
  12. "Planning and navigation“
  13. "Graph Search"

Practicum of Measurement and Data Acquisition systems

- New lectures with code examples (one integral PPT)
- Videos [in Serbian] https://www.youtube.com/watch?v=1G_sXTiic70&list=PLBOIVFwYlUrJvA6Bf33dFwOtOPBF1m

Practicum of Measurement and Data Acquisition systems – new book [in Serbian]

Milica Janković, Marko Barjaktarović, Marija Novičić, Petar Atanasijević

Deo I – Primena LabVIEW softvers
merno-akvizicionim sistem

Practicum of Measurement and Data Acquisition systems – new book [in Serbian]

Milica Janković, Marko Barjaktarović, Marija Novičić, Petar Atanasijević

2

Deo II – Primena *Arduino* platforme i *Python* softverskog alata u merno-akvizicionim sistemima

Practicum of Measurement and Data Acquisition systems – new book [in Serbian]

Milica Janković, Marko Barjaktarović, Marija Novičić, Petar Atanasijević

LEKCIJA 11 – SERIJSKI PORT. KORIŠĆENJE PREKIDA. PRIMENA SENZORA I AKTUATORA.

LEKCIJA 12 – UVOD U *PYTHON* PROGRAMSKI JEZIK ... 173

LEKCIJA 13 – KREIRANJE GRAFIČKOG INTERFEJSA U *PYTHON*-U ... 195

4

Practicum of Measurement and Data Acquisition systems – new book [in Serbian]

Milica Janković, Marko Barjaktarović, Marija Novičić, Petar Atanasijević

Na osnovu navedenih zapažanja, zadovoljstvo mi je da zaključim da rukopis "Praktikum iz merno-akvizicionih sistema", autora: dr Milice Janković, docenta, dr Marka Barjaktarovića, docenta, Marije Novičić, master inž., saradnika u nastavi i Petra Atanasijevića, master inž., asistenta, ispunjava sve formalne i suštinske uslove Pravilnika o udžbenicima i drugoj nastavnoj literaturi i predlažem Nastavno-naučnom veću da predmetni rukopis prihvati kao nastavni materijal - udžbenik Elektrotehničkog fakulteta.

U Beogradu, 22.10.2019.

Recenzent:

dr Mirjana Simić-Pejović, v. prof.

„Практикум из мерно-аквизиционих система" је вредан рукопис, који ће свакако, као помоћни уџбеник, студентима бити драгоцен материјал за савладавање и увежбавање метода и начина градње софтверски заснованих мерно-аквизиционих система на најразличитијим хардверским платформама.

Детаљним прегледом рукописа, уочене су мање грешке и записи о њима, са коментарима, остављени у на маргинама рукописа предатог на рецензију. У сваком случају се ради о минорним исправкама које ни у ком случају не подразумевају потребу за било каквом кључном дорадом или изменом рукописа. Рукопис задовољава све услове са техничког и педагошког аспекта и препоручује се за издавање.

Датум: 23.10.2019.

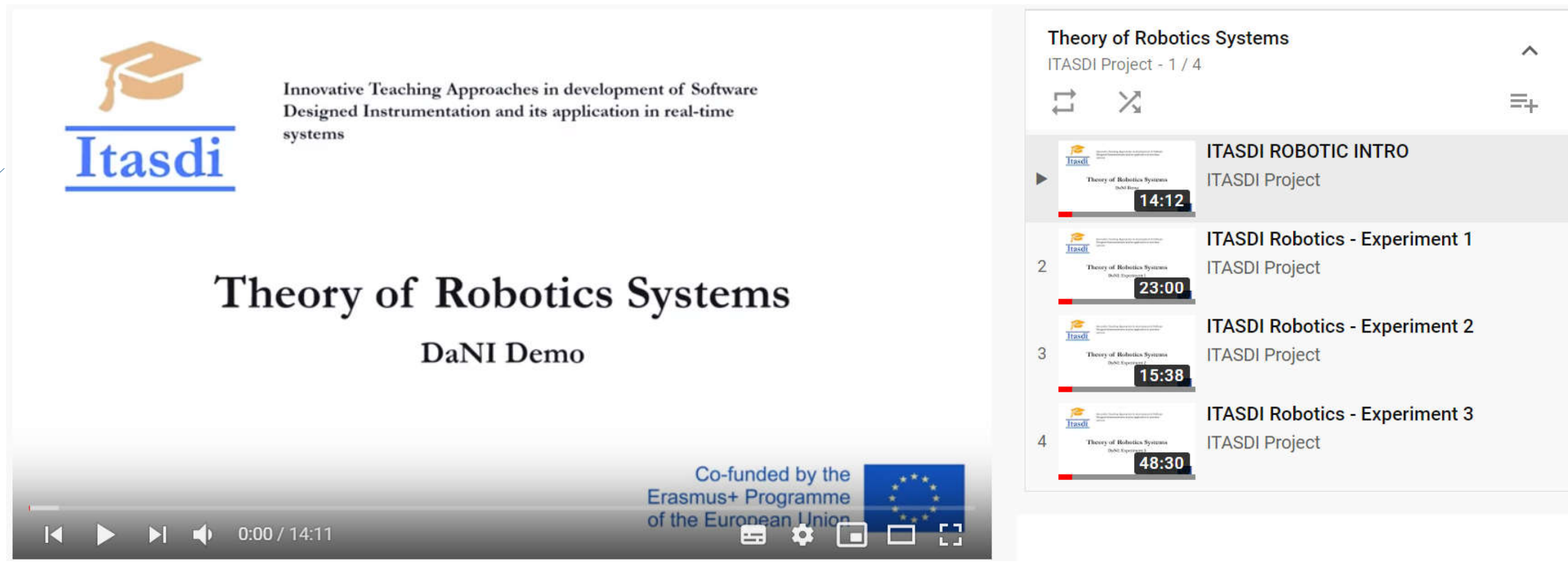
Рецензент:

Др Ненад Миљић, ванр. проф.

UB ITASDI outputs – contribution to the joint book by all ITASDI partners

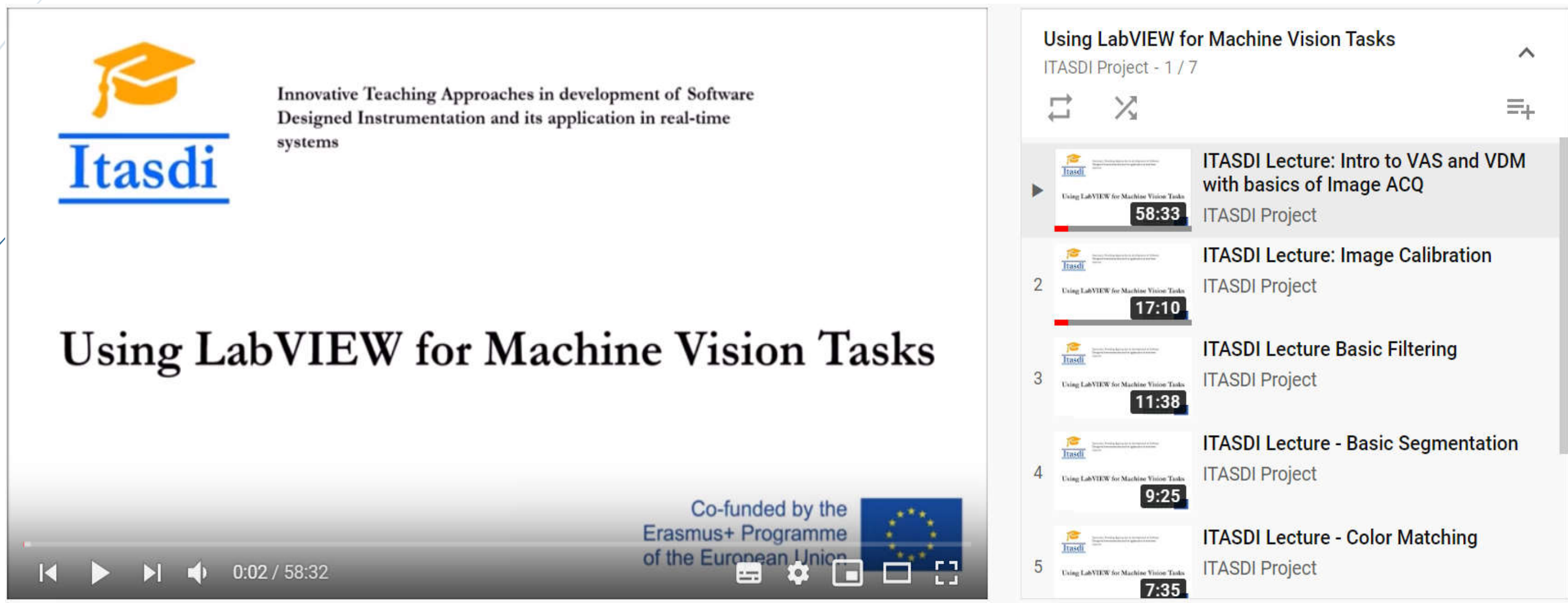
- Three chapters in joint book "Control, virtual instrumentation and signal processing use cases practicum" with the chapter title "Autonomous Mobile Robots – DaNI robot use case“:
  1. "Autonomous Mobile Robots – DaNI robot use case“
  2. "Machine Vision"
  3. "Acquisition systems for electrophysiology"

UB ITASDI outputs – contribution to video playlists



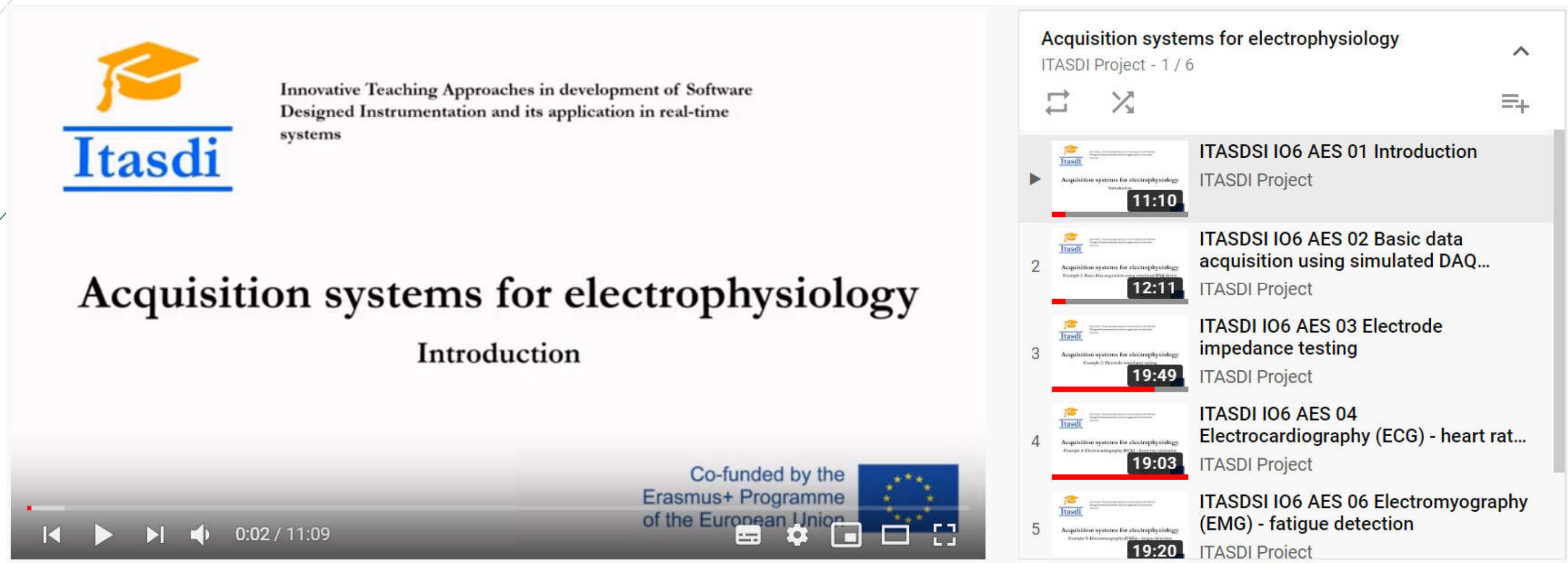
https://www.youtube.com/channel/UCd1oK49H8FFOmyFAjlKXdNw/playlists

UB ITASDI outputs – contribution to video playlists



https://www.youtube.com/watch?v=GCz4s1U3cN0&list=PLBOlVFwYlUrLWDgbft6ixQpk06uj1HmlV

UB ITASDI outputs – contribution to video playlists



https://www.youtube.com/watch?v=TTT_Ro9jwwU&list=PLBOlVFwYlUrIZDRtxrd2rLh72Kn1N0BrT

“New trends in automatization and robotics”

Kosta Jovanović, Ass. Prof.

ETF Robotics lab

University of Belgrade – School of Electrical Engineering

Co-funded by the Erasmus+ Programme of the European Union

Itasdi

ETF Robotics lab

- Kosta Jovanović (age 33, Assistant Professor)

Research areas: physical human-robot interaction, variable impedance actuators, model-based robot control, robot modelling and simulation.

- Vladimir Petrović (age 32, PhD student)

Research areas: artificial intelligence, virtual agents, virtual laboratories

- Zaviša Gordić (age 30, PhD student)

Research areas: collision detection, robot callibration, dynamic parameter identification

- Branko Lukic (age 29, PhD student)

Research areas: physical human-robot interaction, variable impedance actuators, robot control.

- Nikola Knežević(age 26, PhD student)

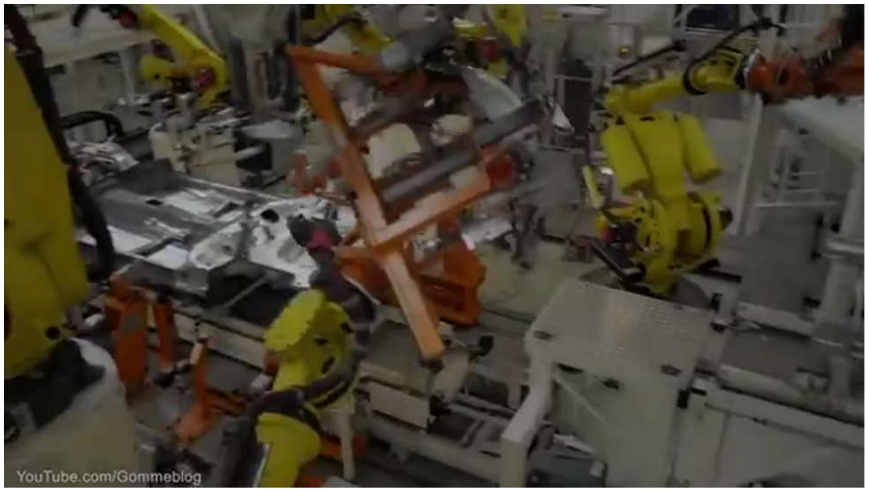
Research areas: variable impedance actuators, machine learning in robotics.

- Maja Trumić (age 26, PhD student)

Research areas: adaptive robot control, variable impedance actuator, impedance estimation.

Automation and robotics
- stady state -

- Charli's time Vs Common production line today



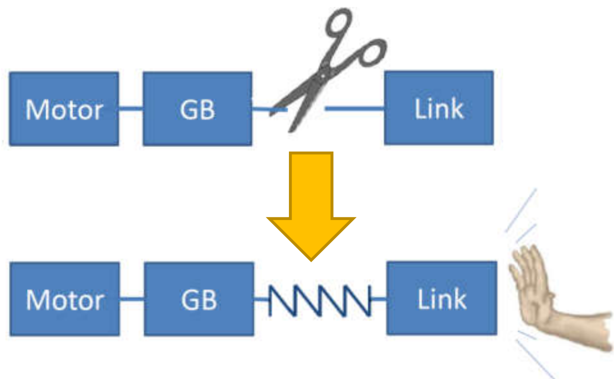
- Robots are designed and manufactured to achieve high performances (repeatability/precision and velocity)! But, to work in a cage or human-free environment, fully deterministic

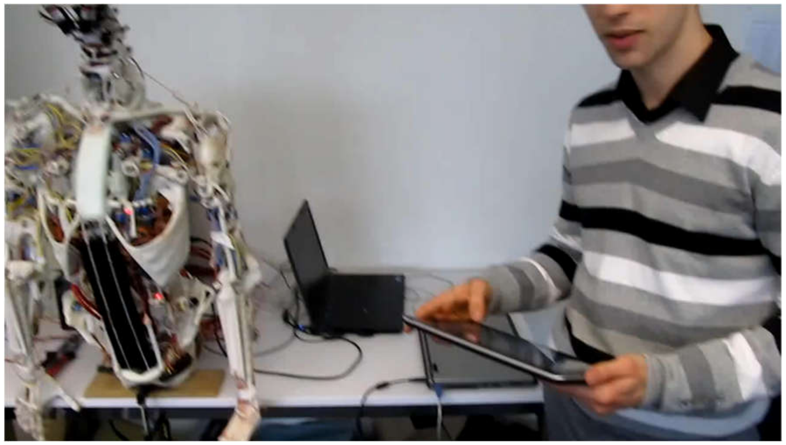
Automation and robotics
- state-of-the-art -

- Robots are designed to be MORE safe and collaborative!
- Goal – to bring the robot on the workbench with humans and save working space, while still comply with safety!
- Collaborative robots – generetion 1: sensor-based safety

Automation and robotics
- next level -

- Robots are designed to be INHERENTLY safe and collaborative!
- Collaborative robots – generetion 2: **actuator-based** + sensor-based safety



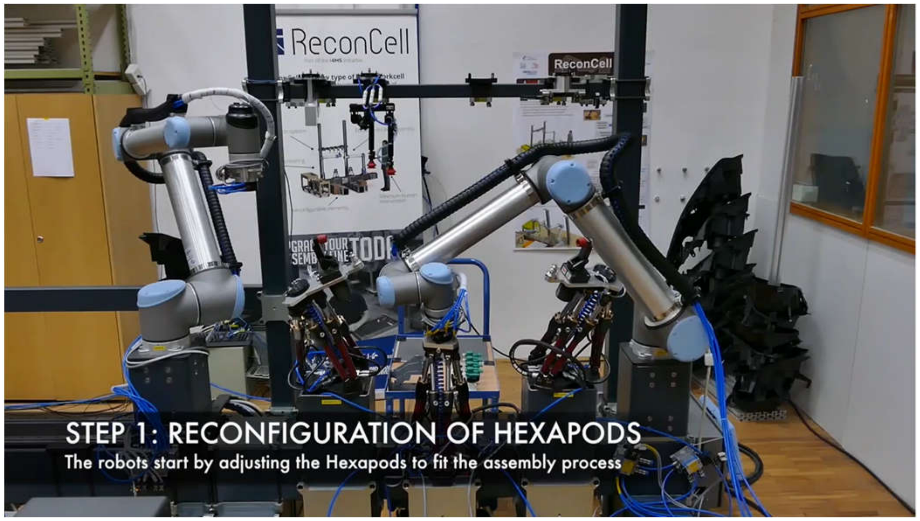


Automation and robotics
- next level -

- Robots are designed to be tailor-made for SMEs!
- Small batch production, easily reconfigurable, skill-free re-programed
- Horizon 2020 project ReconCell project experiment (coordinated by JSI):

In collaboration Ivamax

“Reconfigurable Assembly od Airport Signalization Lights using Collaborative Robots”



Co-funded by the Erasmus+ Programme of the European Union

"New trends in automatization and robotics"

Email: kostaj@etf.rs

Kosta Jovanović, Asst. Prof.

ETF Robotics lab

University of Belgrade – School of Electrical Engineering

Itasdi

Co-funded by the Erasmus+ Programme of the European Union

System testing in the automotive industry

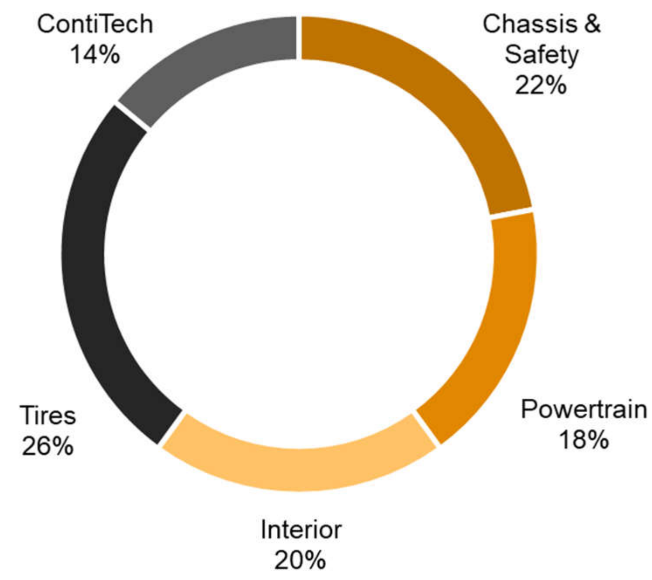
Nikola Stanković

Continental Automotive d.o.o Novi Sad

Continental Corporation Overview 2018

- Since 1871 with headquarters in Hanover, Germany
- Sales of €44 billion in 2018
- 243,226 employees worldwide
- 544 locations in 60 countries & markets

Sales by division in %



Continental corporations
Five Strong Divisions

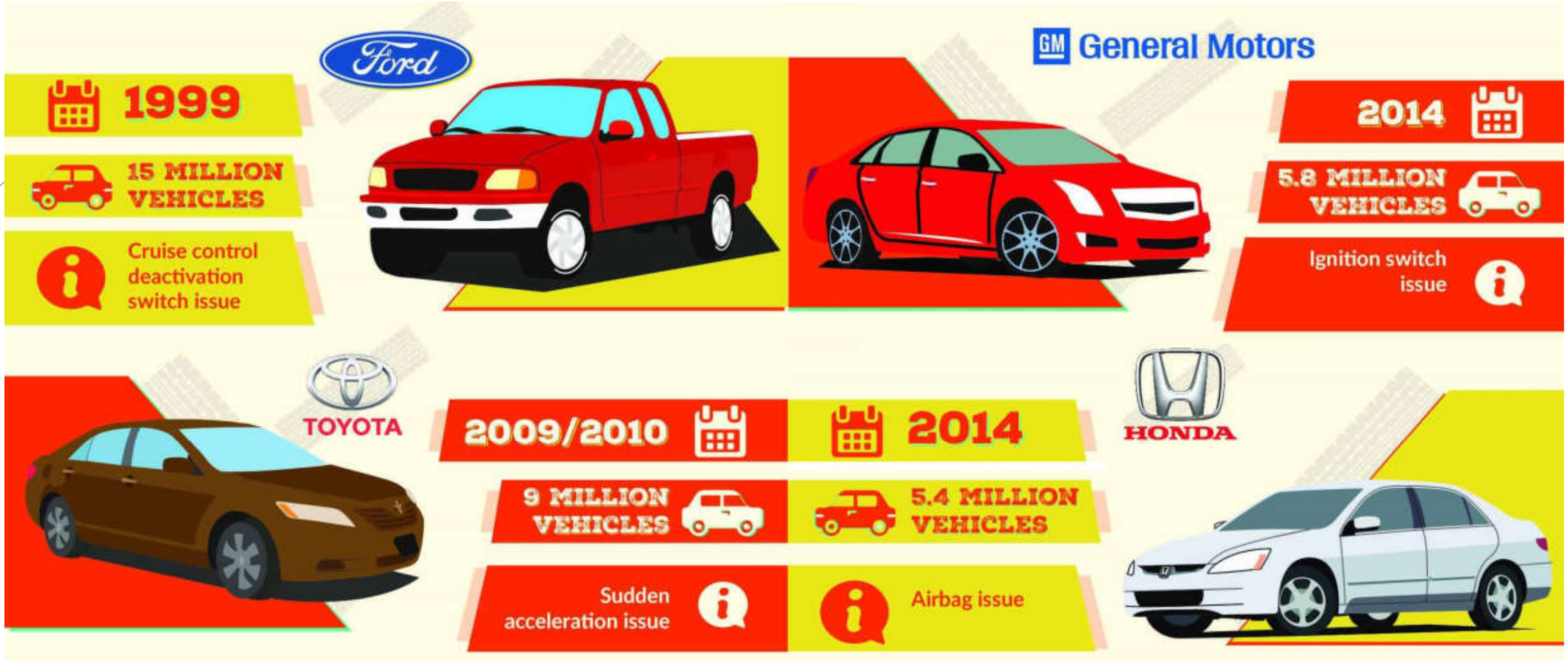
Chassis & Safety	Powertrain	Interior	Tires	ContiTech
Vehicle Dynamics	Engine Systems	Instrumentation & Driver HMI	PLT, Original Equipment	Air Spring Systems
Hydraulic Brake Systems	Fuel & Exhaust Management	Infotainment & Connectivity	PLT, Repl. Business, EMEA	Benecke-Hornschuch Surface Group
Passive Safety & Sensorics	Hybrid Electric Vehicle	Intelligent Transportation Systems	PLT, Repl. Business, The Americas	Compounding Technology
Advanced Driver Assistance Systems (ADAS)	Sensors & Actuators	Body & Security	PLT, Repl. Business, Asia Pacific	Conveyor Belt Group
	Transmission	Commercial Vehicles & Aftermarket	Commercial Vehicle Tires	Elastomer Coatings
			Two Wheel Tires	Industrial Fluid Solutions
				Mobile Fluid Systems
				Power Transmission Group
				Vibration Control

PLT – Passenger and Light Truck Tires

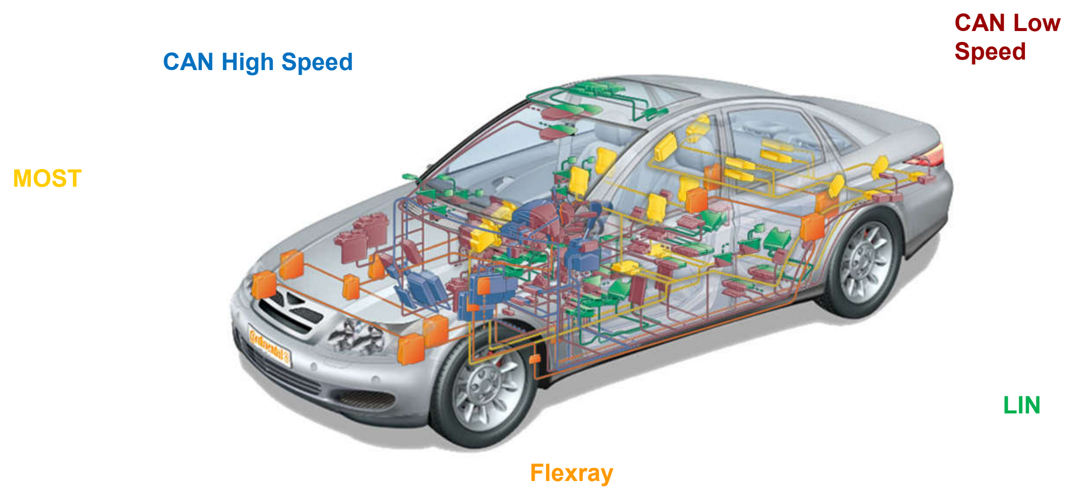
Continental automotive in Novi Sad

- Situated in the city center with 6400 m², on 6 floors, enough for 550 people
- At the moment 350 engineers across 2 Business Units
- Setup of all engineering disciplines(SW, VV, EE, ME)
- Close collaboration with world leading OEMs

Why System testing in the automotive?

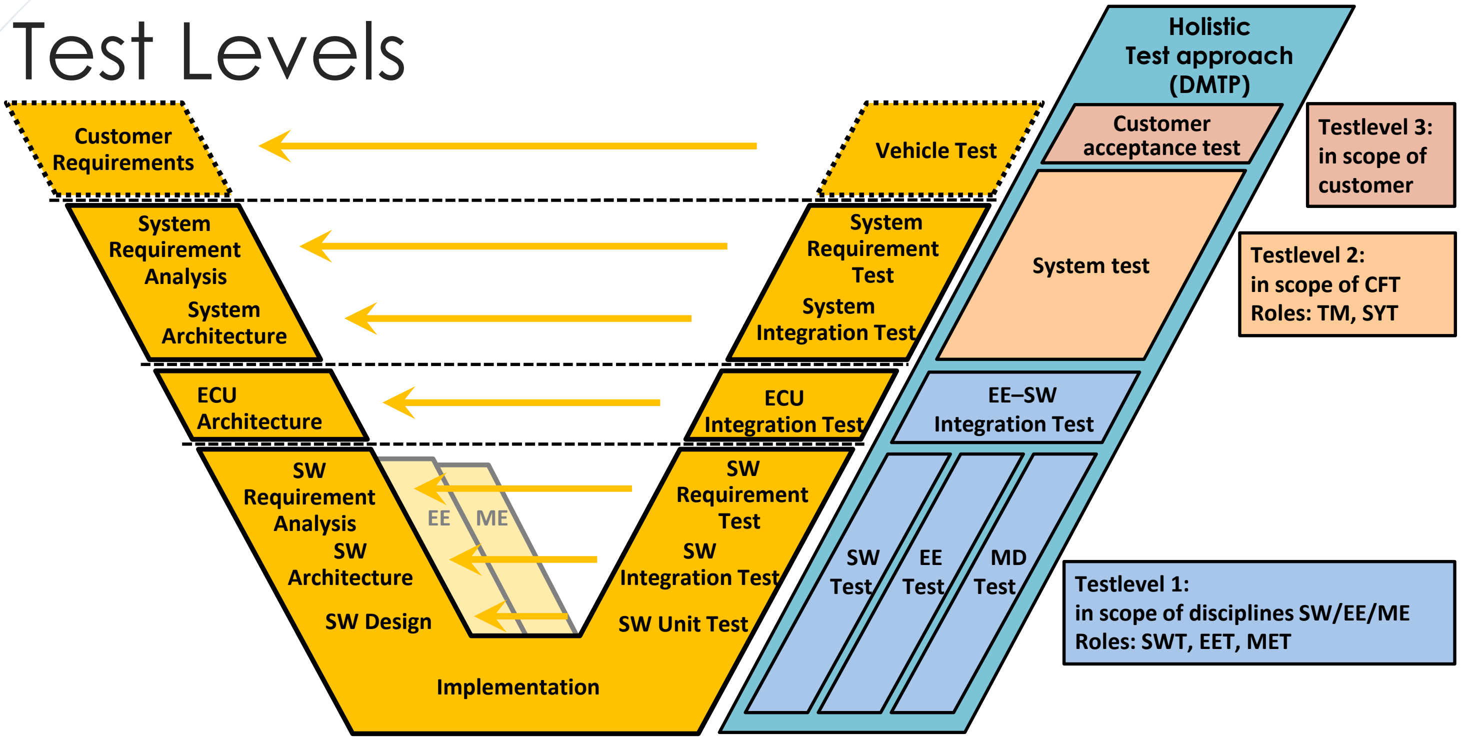


Are the systems complex?



Methodology

Test Levels



ECUs and Black box testing

Instrumentation and Driver HMI:

Body controller:

Telematic devices and Tachographs:

Keys:

OBD dongles:

Simulation

- System Test Engineer simulates electrical signals, environments, disturbances and verifies if the captured output is valid
- Functional vs non-functional testing
- Equipment: Test boxes
- Power supplies
- Oscilloscopes
- Signal generators
- NI test solutions - STARS

Thermal chamber

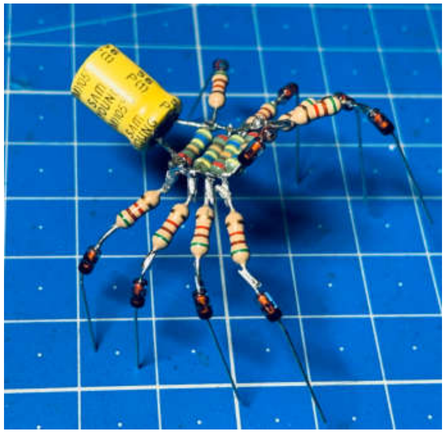
NI Mini Stars

Generic Test Box

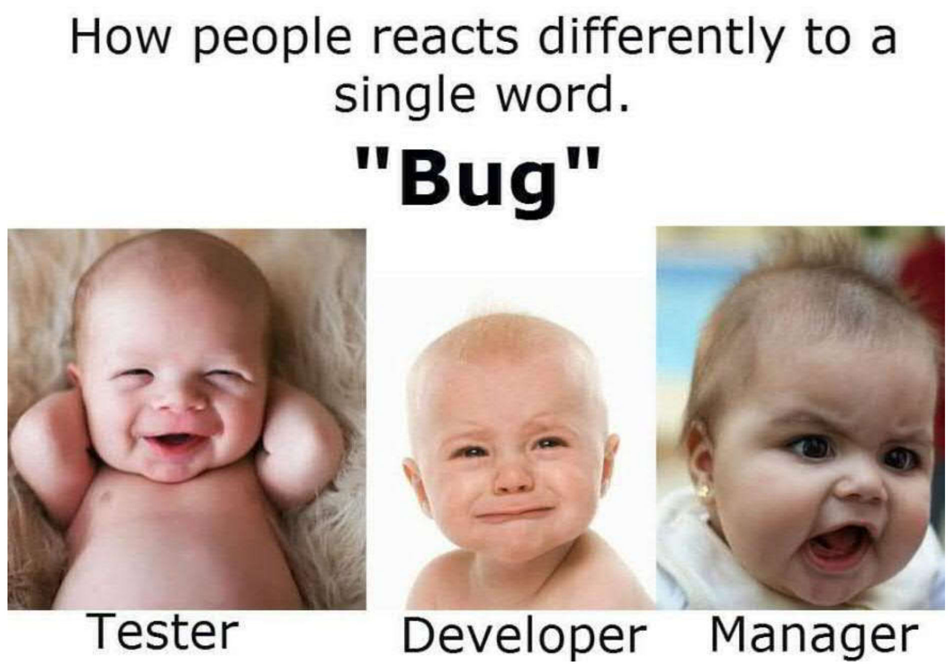
What signals are under the hood?

- Digital inputs and outputs

- Analog Inputs – Voltage and resistive sensors



“Soft” skills


How people reacts differently to a single word.
"Bug"
Tester
Developer
Manager

Thank you

- Questions?
- Job/internship positions?
- Check our Infostud page or contact us directly: career-novisad@continental-corporation.com
- If you want to get in touch with me for any more questions: Nikola.Stankovic@continental-corporation.com

Itasdi

Co-funded by the Erasmus+ Programme of the European Union

Semiautomated EOL production tester – when time matters

Dušan Vukašinović,

Managing director

NOFFZ-Forsteh Technologies

Company Overview

- Test and Measurement consultants and solution providers
- Highly available local technical assistance exactly according to specific needs through entire project lifecycle
  - Technical consultations and support,
  - Engineering assistance during project development and
  - Full turnkey solutions
- We are:
  - National Instruments Alliance partner and
  - Chroma ATE regional distributor

Scope of Services

- Test systems (R&D V&V, HIL, EOL production)
  - Consulting and feasibility studies
  - Test concepts and plans
  - Software architectures and test development
  - Test automation
  - Custom interface PCBs
  - Test fixtures and mass interconnections
  - Test system assembly
- Software tools development (frameworks, libraries, instrument drivers)
- Custom measurement systems

Forsteh is now part of NOFFZ group

Forsteh

NOFFZ
TECHNOLOGIES

Embedded world

- Everything around us is turning to electronics
- Millions of pieces of PCBAs are manufactured daily around the globe
  - Automotive
  - Consumer electronics
  - Medical
  - Telecommunication
  - Etc.
- Quality control is critically important
  - Safety
  - Customer experience

Time matters

- We all know that size matters, but what is with time?
- Is 1s reduce of test time important?
- 1.000.000 pieces / year -> time saving 37 working days!
- Test time depends of DUT complexity, but also on test equipment
- Measurement time is (almost) always same
- So, where is challenge than?

Where is challenge?

- Most typical challenges on production floors
  - Communication -> devices config, results fetch
  - Multiplexing -> very intensive, (usually) time consuming communication
  - IN/OUT handling -> manual operation
- Critical importance
  - Latency (PCI vs others) – test equipment, DB communication
  - Data types – integer/float vs string
  - Way how are drivers implemented
  - DUT handling automation

Case study – Johnson Electric Nis

- Automotive product
- High quantity
- >99.7% uptime
- 24/7 operation
- Fully custom solution
- **Sevral test time reduction improvements**

National Instruments vs. Rigol DMM

National Instruments

- **PXIe (PCIe)** based DMM & Multiplexer
- Automatic handshake on PXI backplane
- Data in **numeric** format (float)
- 30 measurements = **1.5 seconds**
- **~4.000,00 EUR**

Rigol

- **LXI or GPIB** based DMM **with** Multiplexer as module
- Automatic handshake in mainframe
- Data in **string** format
- 30 measurements = **5 seconds**
- **~2.000,00 EUR**

Other time-consuming operations

- In-tester transport time
- Communication with ERP
  - fetching per SN status – test can start only after all previous steps passed OK,
  - Test results announcement - only after test results successfully stored to ERP
- Change-over time
- Maintenance time
- Debugging / troubleshooting (!)

Questions & Next steps

?

- We always have internship positions opened
- **Currently 2 open positions for full time test engineer!**

Dušan Vukašinović
Managing director

NOFFZ-Forsteh Technologies doo

Tel: +381 11 3977 542
Mobil: +381 64 136 84 14
E-Mail: dusan.vukasinovic@noffz.com

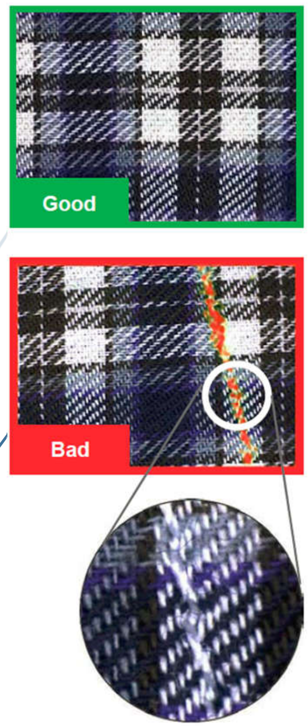
Co-funded by the
Erasmus+ Programme
of the European Union

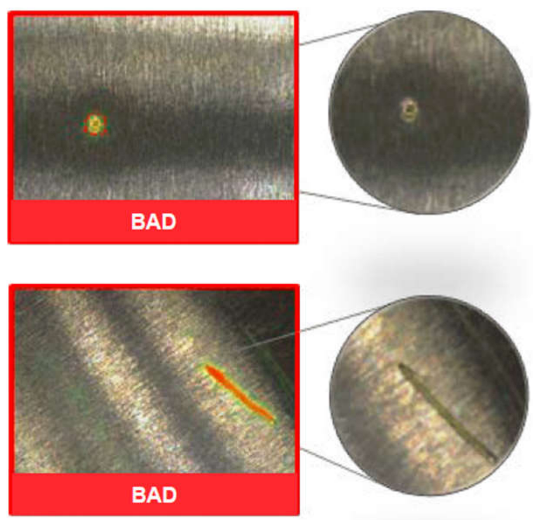
“New trends in machine vision systems”

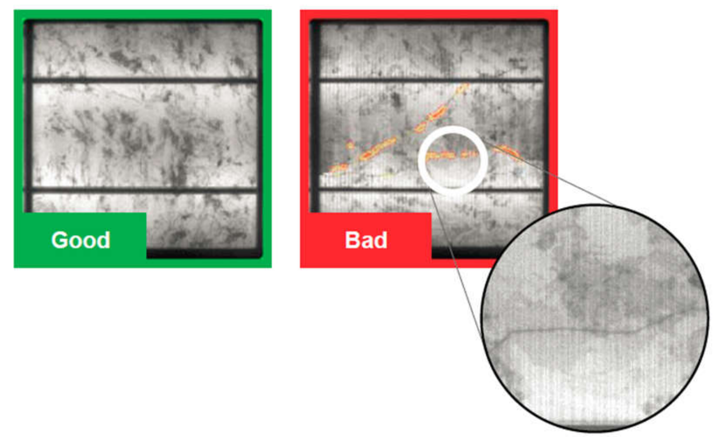
Marko Barjaktarović, Ass. Prof.

University of Belgrade – School of Electrical Engineering

DEEP LEARNING IN QUALTY CONTROL AND IDENTIFICATION



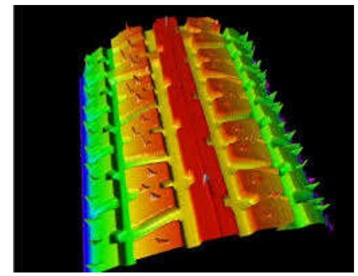




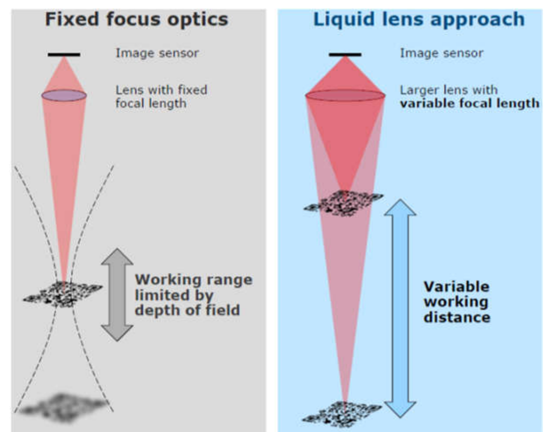
3D MEASUREMENTS

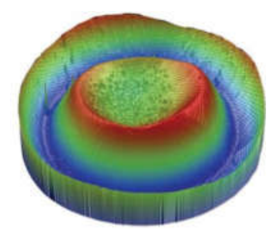
Bin picking

High speed laser scanners



ToF



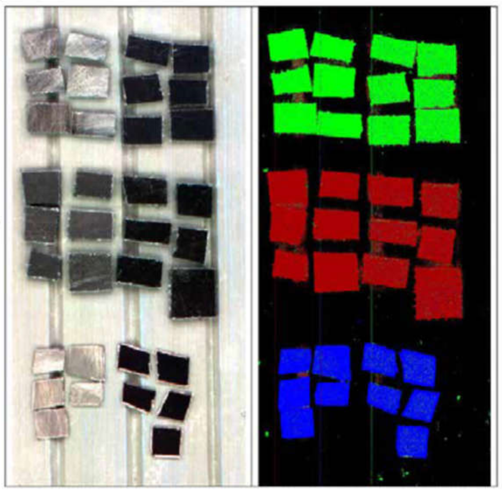


Liquid lens

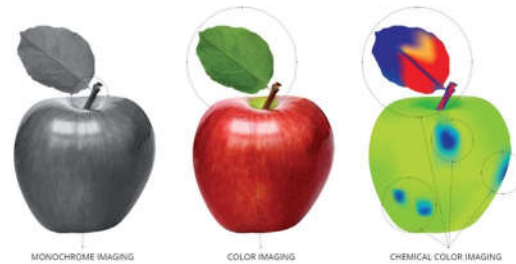
25/10/2019

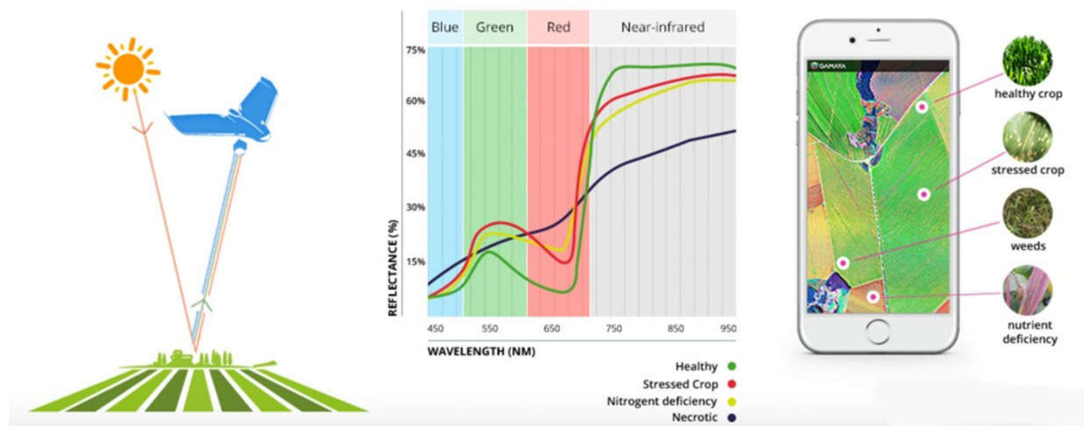
HYPERSPECTRAL (MULTISPECTEAL) IMAGING

Recycling – 3 type of plastic



Food inspection





Agricultural inspection

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Co-funded by the Erasmus+ Programme of the European Union

Machine for Real-Time Visual inspection and Selection in Bullet Production

Aleksandar Gogić, UNO-LUX NS, Belgrade

About company

- Founded in 1992
- National Instruments Silver Alliance partner for over 15 years
- Core activities:
  - Production
  - Research and development
  - Engineering
  - Education


AI0
AI1
AI2
AI3


UNO-LUX NS
www.unoluxns.com
D1
D2


SISTEM KONTROLE ZA JKP VODOVOD I KANALIZACIJA POZAREVAC - SCADA APLIKACIJA

Machine vision system design steps

1. Inspection goals
   - Cost budget and the application benefits
   - System variations
   - Human operator profile
2. Inspection time
   - Type of cameras (analog or digital)
   - Image-acquisition hardware
3. Defects/Features

Machine vision system design steps

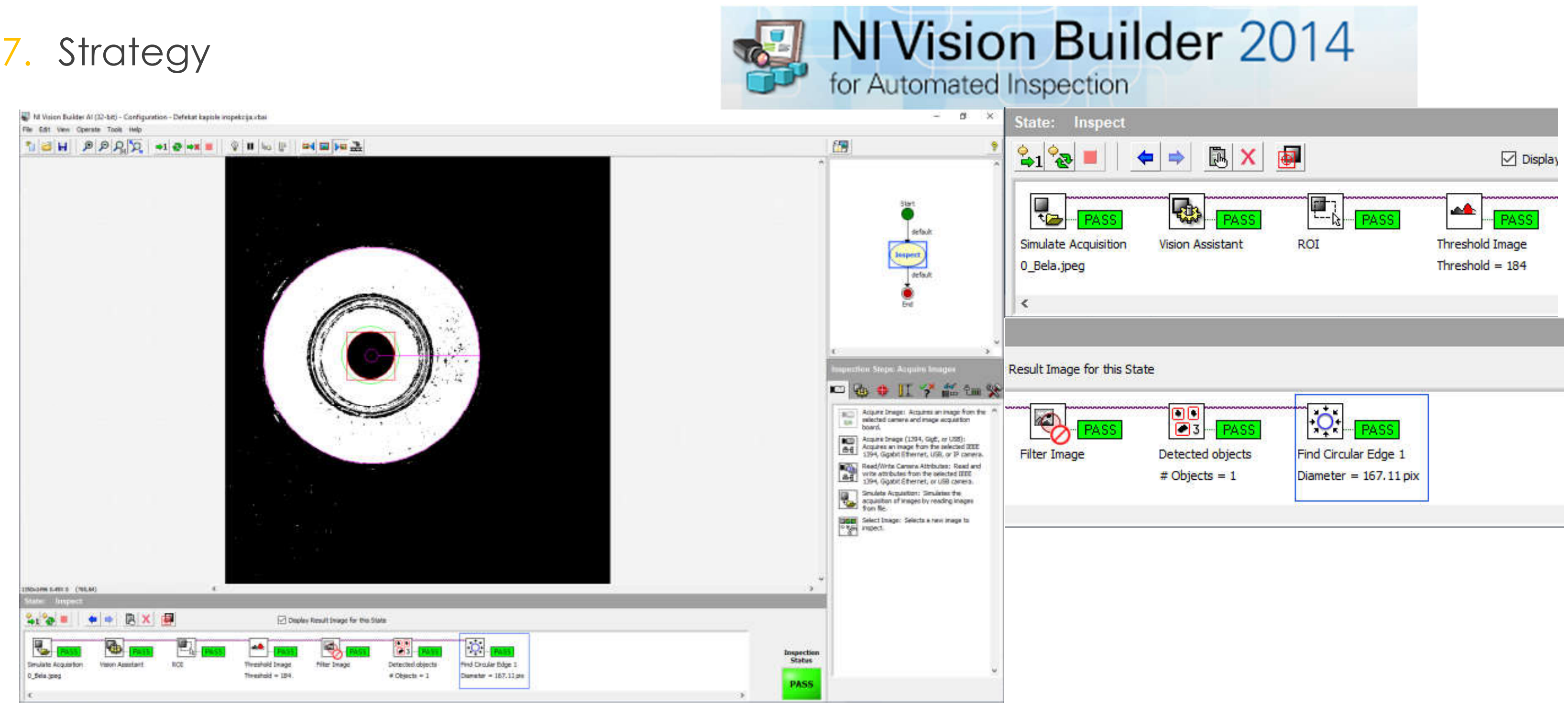
4. Lighting

5. Optics
   - Minimum resolution
   - Field of view (FOV)
   - Working distance

6. Image acquisition hardware
   - Analog or digital camera
   - Monochrome or a color camera
   - Linescan or area-scan camera

Machine vision system design steps

7. Strategy



Machine vision system design steps

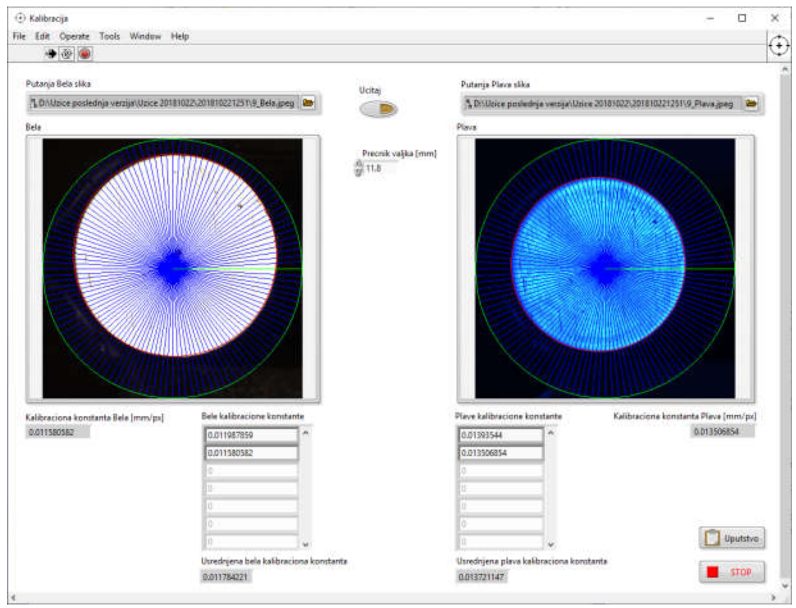
8. Integration of systems

9. Calibration and testing the inspection
   - Quantification of the camera, lens and lightning system
   - Saving images
   - Off-line software for testing inspection parameters

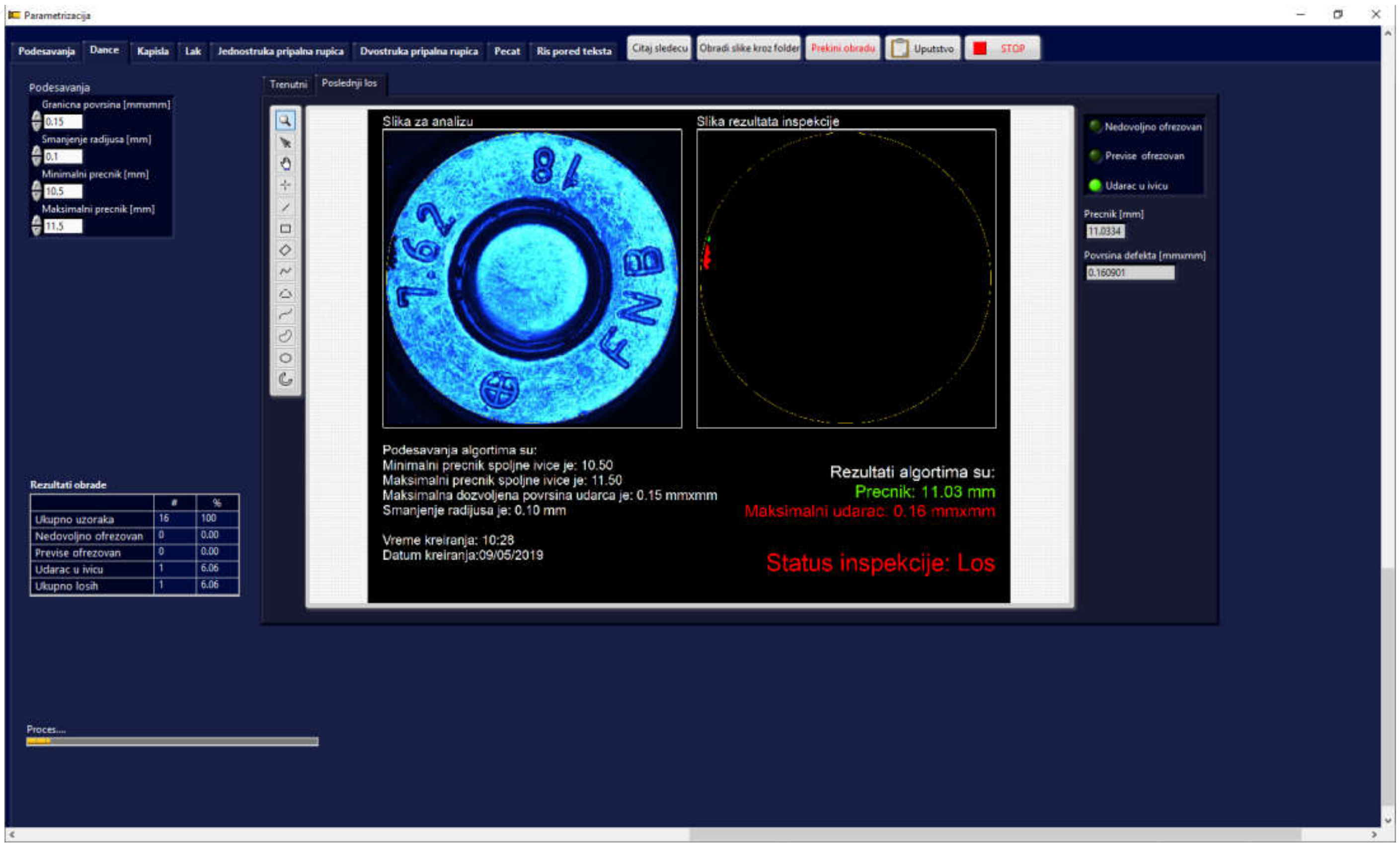
Defect	I	II	III
Repeatability[%]	100	99.8	99.9

Machine vision system design steps

10. Operator interface

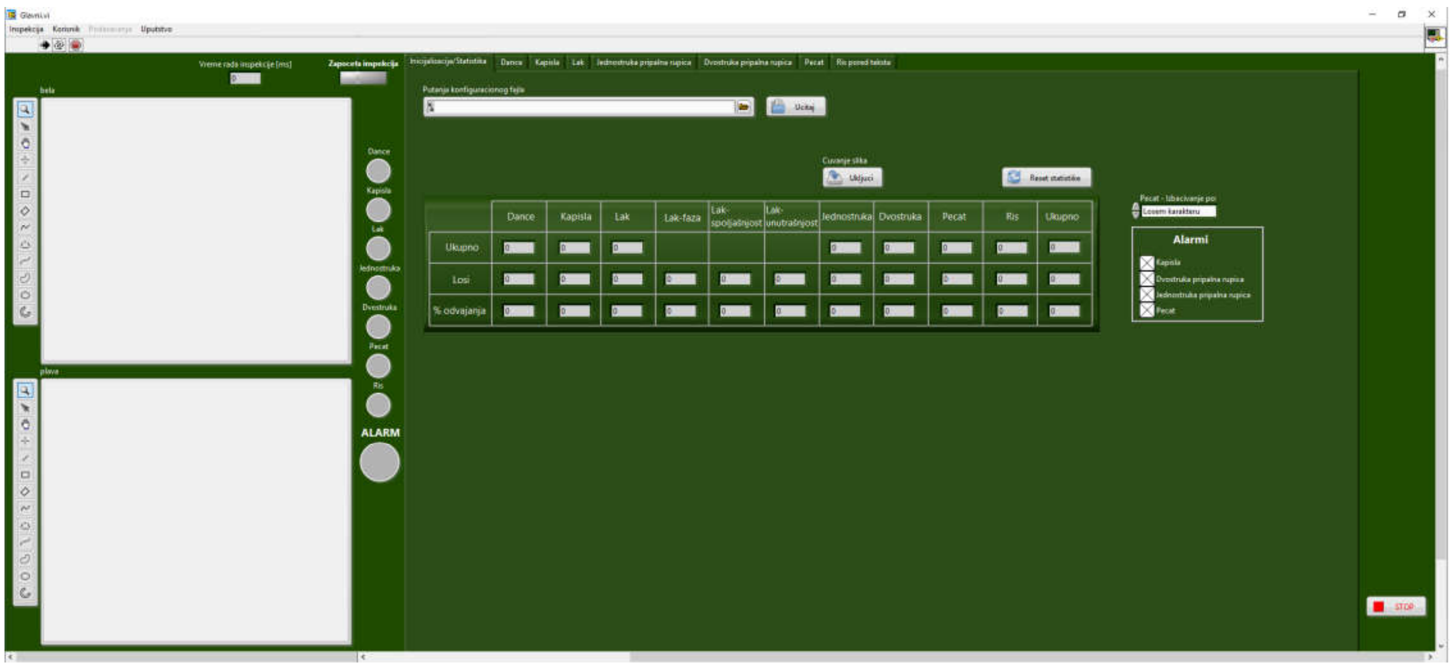


Machine vision system design steps

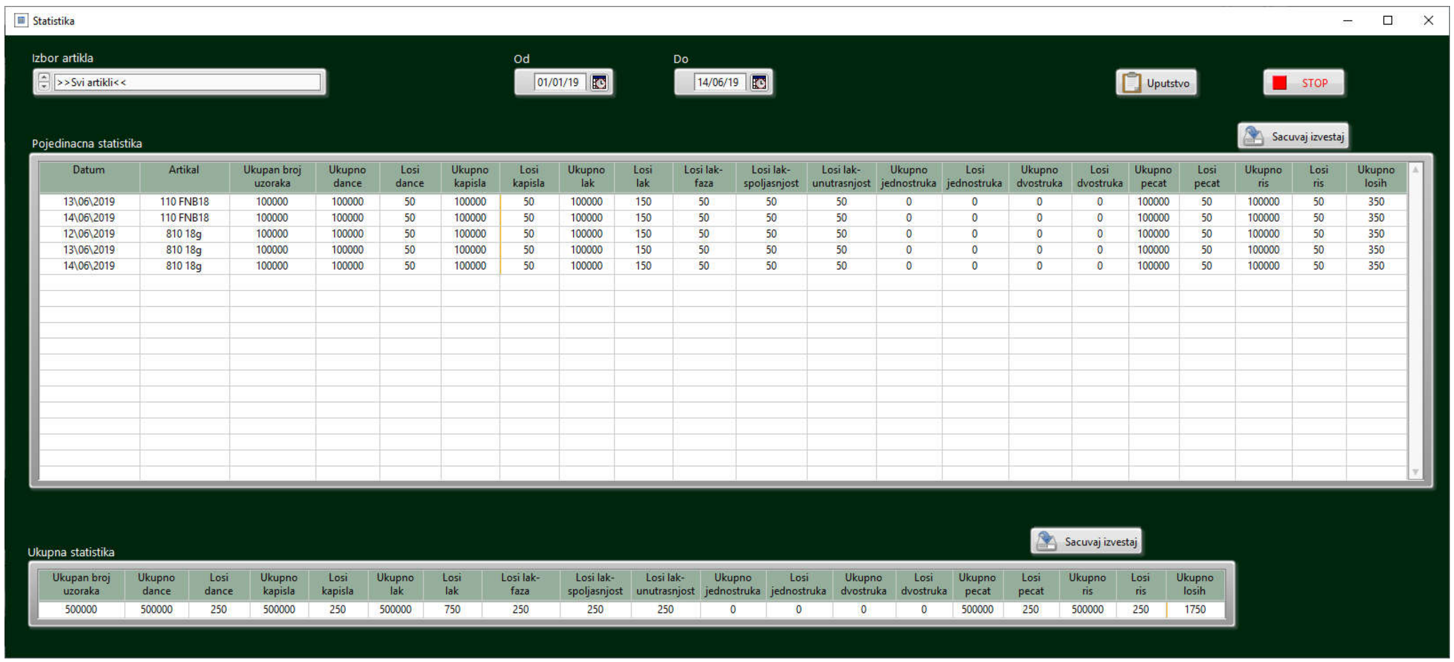


Machine vision system design steps

Machine vision system design steps



Machine vision system design steps



Datum	Artikal	Ukupan broj uzoraka	Ukupno dance	Losi dance	Ukupno kapisla	Losi kapisla	Ukupno lak	Losi lak	Losi lak-faza	Losi lak-spoljasnjost	Losi lak-unutrasnjost	Ukupno jednostruka	Losi jednostruka	Ukupno dvostruka	Losi dvostruka	Ukupno pecat	Losi pecat	Ukupno ris	Losi ris	Ukupno losih
13\06\2019	110 FNB18	100000	100000	50	100000	50	100000	150	50	50	50	0	0	0	0	100000	50	100000	50	350
14\06\2019	110 FNB18	100000	100000	50	100000	50	100000	150	50	50	50	0	0	0	0	100000	50	100000	50	350
12\06\2019	810 18g	100000	100000	50	100000	50	100000	150	50	50	50	0	0	0	0	100000	50	100000	50	350
13\06\2019	810 18g	100000	100000	50	100000	50	100000	150	50	50	50	0	0	0	0	100000	50	100000	50	350
14\06\2019	810 18g	100000	100000	50	100000	50	100000	150	50	50	50	0	0	0	0	100000	50	100000	50	350

Ukupan broj uzoraka	Ukupno dance	Losi dance	Ukupno kapisla	Losi kapisla	Ukupno lak	Losi lak	Losi lak-faza	Losi lak-spoljasnjost	Losi lak-unutrasnjost	Ukupno jednostruka	Losi jednostruka	Ukupno dvostruka	Losi dvostruka	Ukupno pecat	Losi pecat	Ukupno ris	Losi ris	Ukupno losih
500000	500000	250	500000	250	500000	750	250	250	250	0	0	0	0	500000	250	500000	250	1750

Questions?

UNO-LUX NS

www.unoluxns.com
aleksandar@unoluxns.com

Itasdi

Co-funded by the Erasmus+ Programme of the European Union

New Trends in Electronics

Nenad Jovičić, Assoc. Prof.

University of Belgrade - School of Electrical Engineering

What is Electronics

Electronics is :

- It started as the part of physics concerned with the behaviour and movement of electrons in isolators, semiconductors or conductors.
- It continued as the branch of technology concerned with the design of devices and circuits used to build analog and later digital computers.
- Today it is the branch of engineering that develops support for the majority of other engineering areas.

Where is Electronics Today?

Integrate circuits and systems used in:

- Computers - from Android phone to supercomputer,
- Industry – from time relay to 6-DOF robot,
- Communications – from wired phone to satellite Voyager probe,
- Automotive – from electric scooter to combat plane,
- Consumer electronics – from fridge to smart fridge,
- Measurement systems - From multimeter to high end equipment

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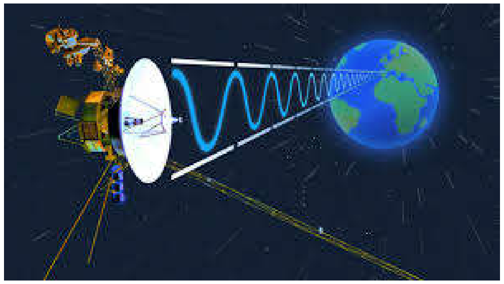

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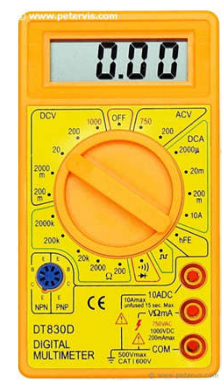
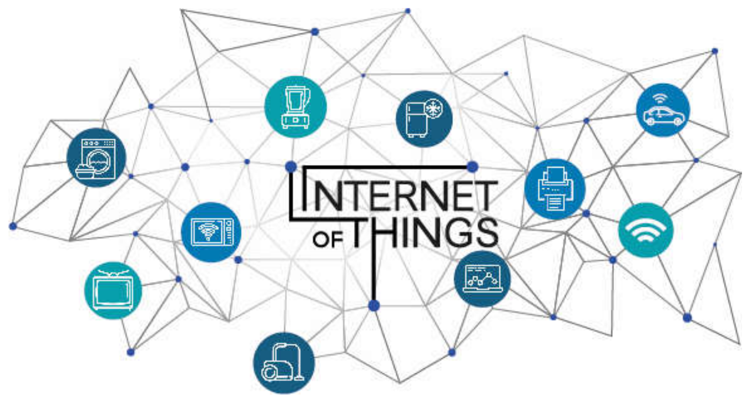


Where is Electronics Going to Be?

Electronics IS the main enabler for the future of:

- Internet of Things (IoT),
- Artificial Intelligence (AI),
- Machine vision,
- Virtual and augmented reality (VR),
- Autonomous vehicles,
- 5G, UWB and other wireless technologies,
- Smart grids, smart factiories, smart cities, smart everything,



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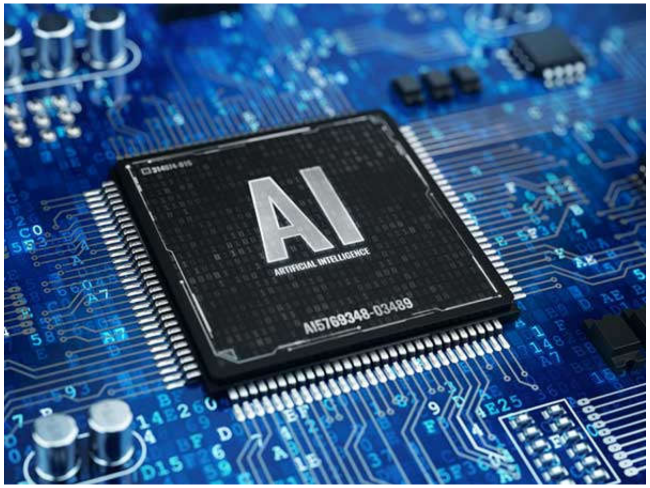

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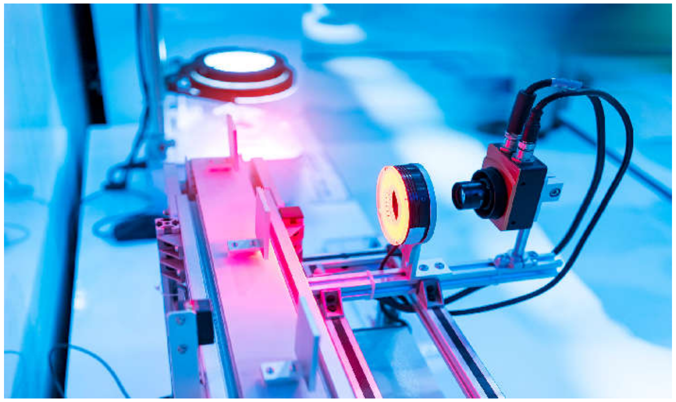

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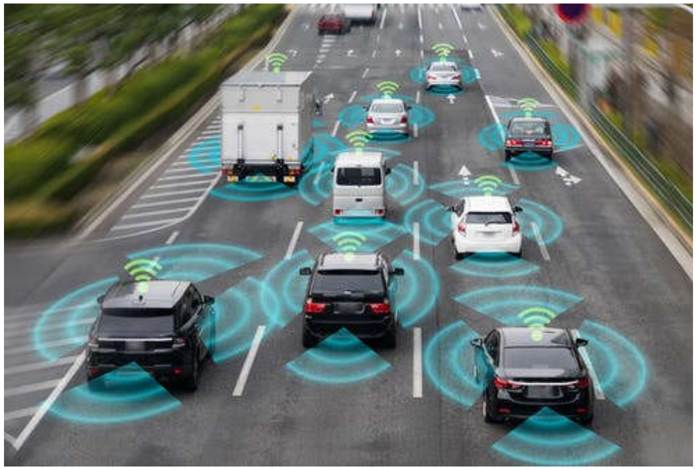

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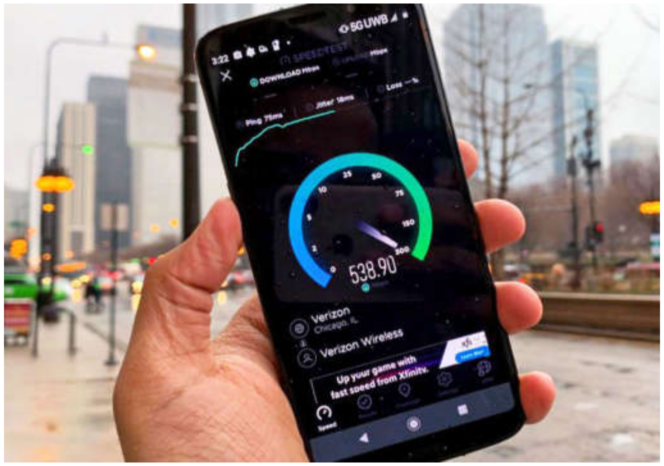

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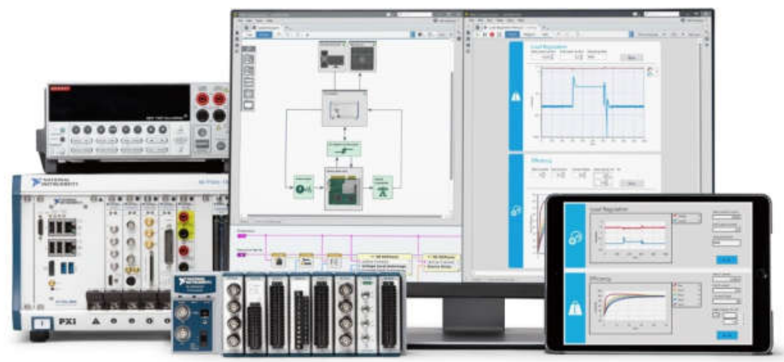
- Smart grids, smart factiories, smart cities, smart everything,
- <u>And finally advanced measurement systems!!! ☺</u>



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Radar frequency control using PWM and LP filters

Ivan Pružljanin, Novelic, Belgrade

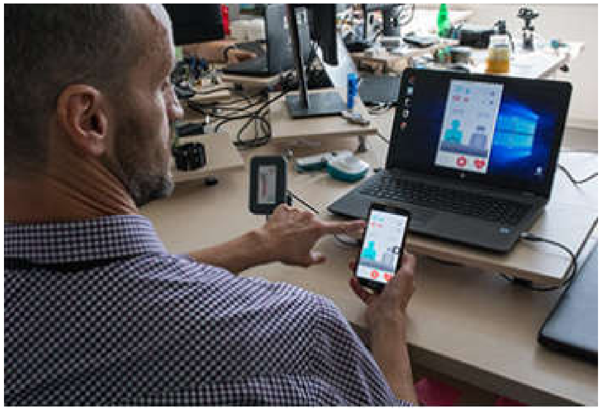
About Novelic

- NOVELIC is a B2B High-Tech Solutions Company for analogue & RF & mm-wave IC, SoC & FPGA, Embedded HW&SW and Signal Processing design.
- The NOVELIC mission is to create premium value for our customers and offer high-tech, innovative and affordable solutions.
- Our vision is to be the customer´s first choice company for mm-Wave short range radar sensor modules in the years to come.

NOVELIC

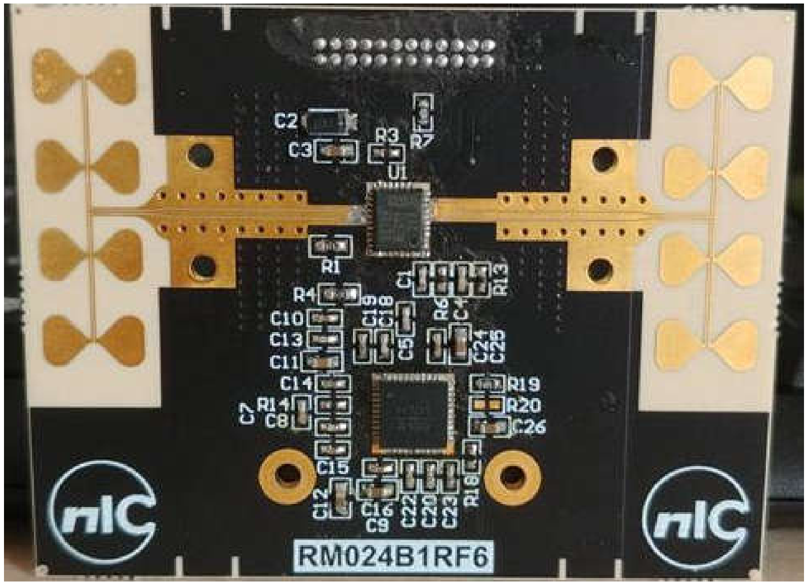
Applications of mm-Wave radar

- Parking Sensor
- Blind Spot Detection
- Industrial Safety
- Breathing and Heartbeat Sensor



The “problem”

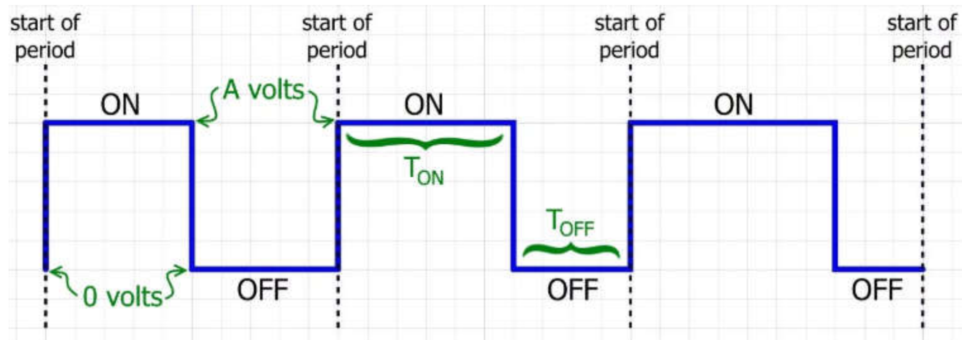
- VCO, PLL
- Price, area…
- Possible solution?

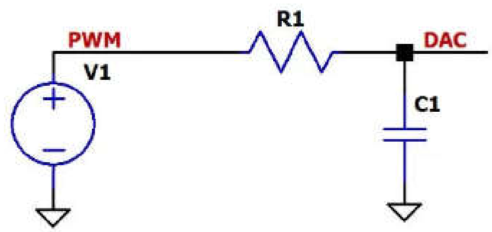


DAC

- Using Input Capture Timer (exists on microcontroller) to measure frequency
- Adjust the frequency using DAC (does not exist on microcontroller that we used, needs to be purchased additionally)
- Is there an even cheaper solution?

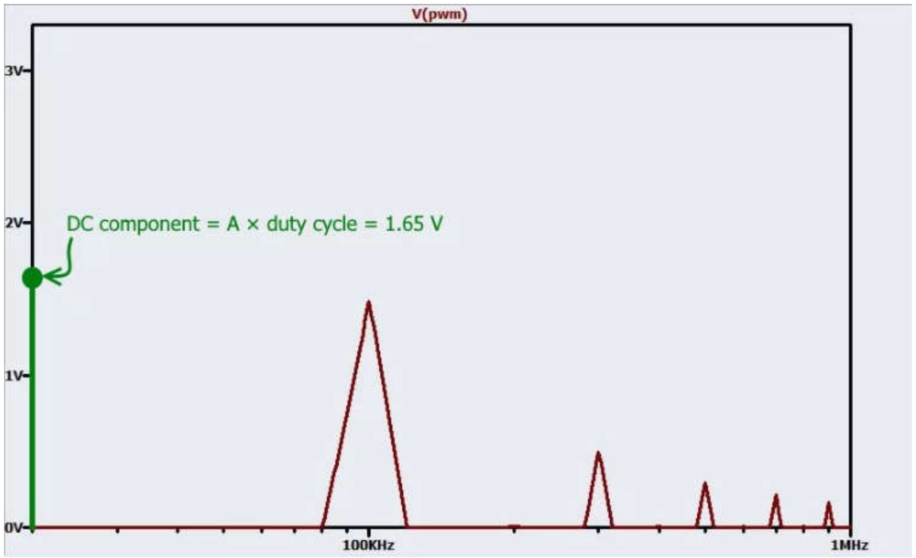
PWM 100 kHZ



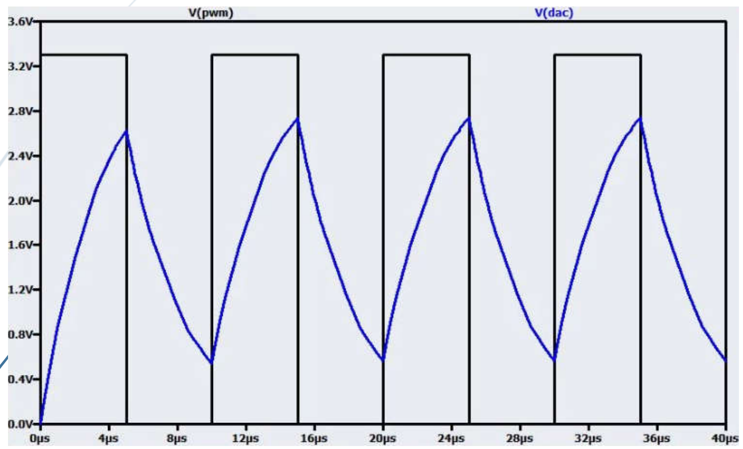


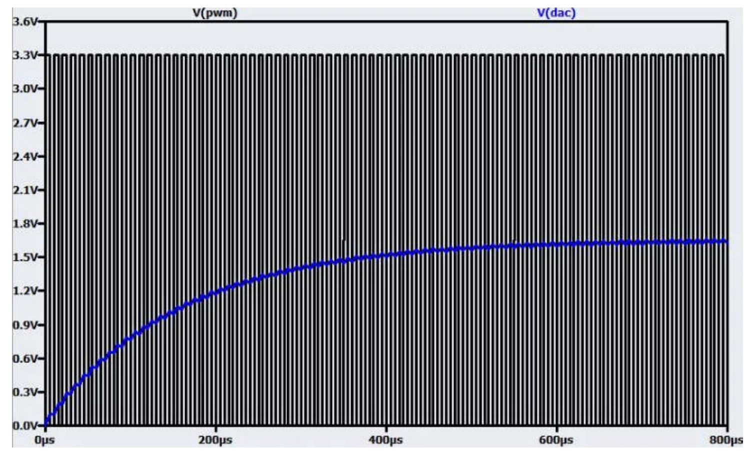
DAC voltage=A volts*duty cycle

PWM spectrum



Choosing the cutoff frequency





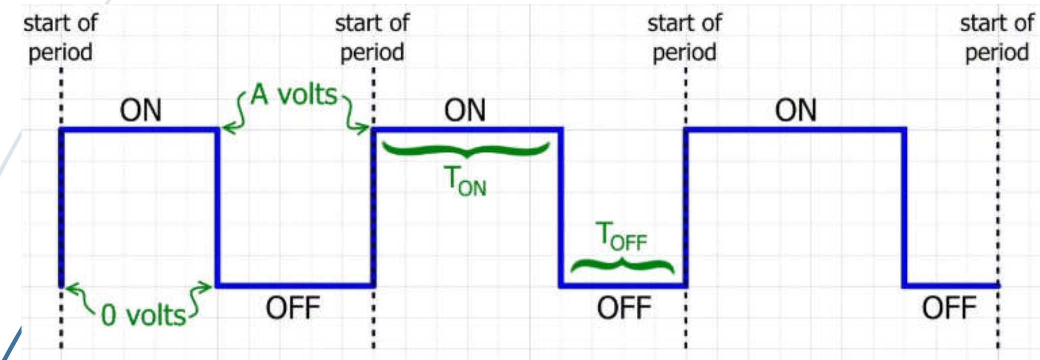
$f = 50\ kHz = 2\pi RC\ \ \mathrm{C} = 10\ nF \Rightarrow R \approx 318\ \Omega$

Too much ripple

$f = 1\ kHz = 2\pi RC\ \ \mathrm{C} = 10\ nF \Rightarrow R \approx 16\ \mathrm{k}\Omega$

Too slow

Limitations of this DAC



- Slow
- Ripple
- A volts depends on logic-high levels (Voltage regulator, battery)

Improvement

- Increase the PWM frequency
- Find the best Low-pass cutoff to satisfy ripple and speed
- Higher order filter

The final slide

- Are there any questions?
- NOVELIC OFFERS INTERNSHIP POSITION IN THE FOLLOWING AREAS:
  - Analog / Mixed Signal IC Design
  - DSP for IoT Radar Sensors
  - Embedded Systems Design
  - Embedded Systems Design, position in Niš
  - FPGA Design
- Apply for the internship, with a one-page CV, and a Cover letter via: internship@novelic.com

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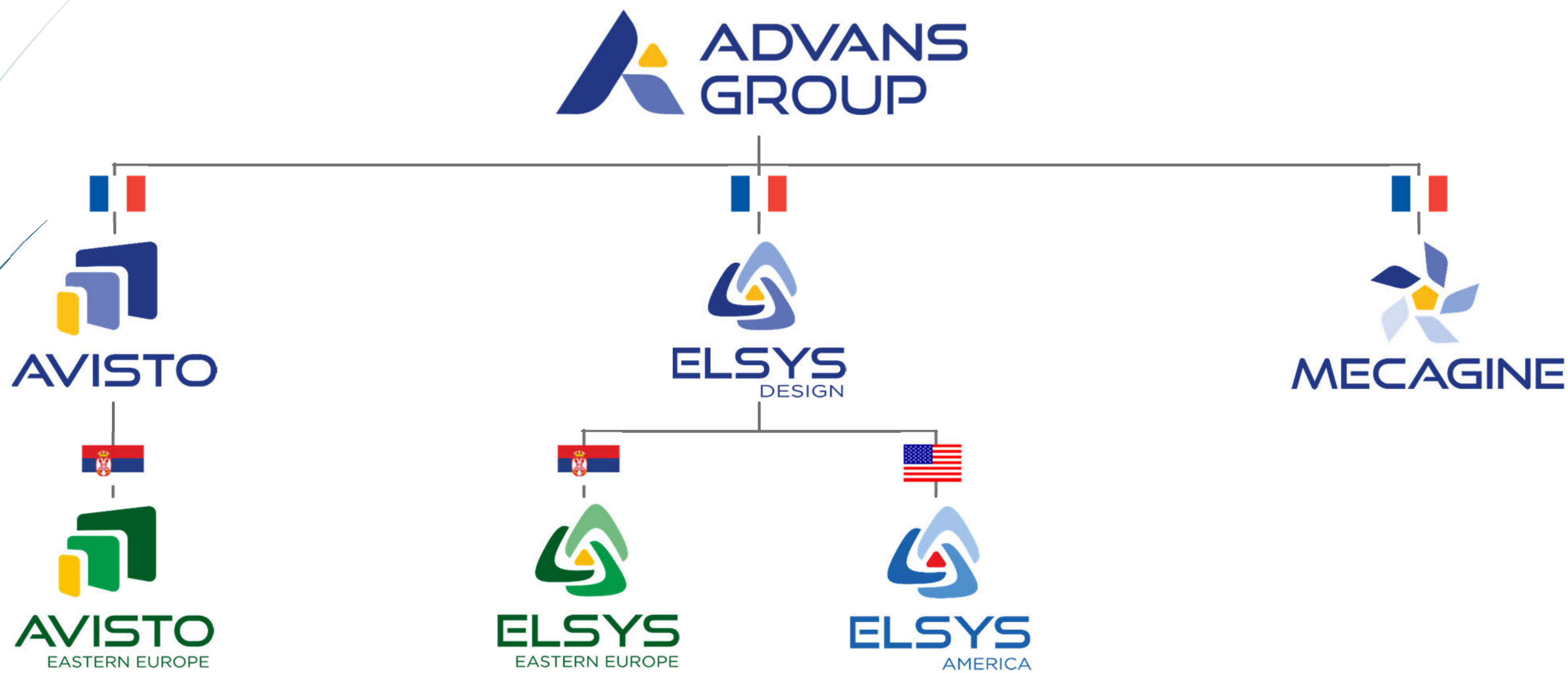
Using LabVIEW for Hardware Verification

Aleksandar Popović, Elsys Eastern Europe, Belgrade

Advans Group Organization



Numerous Fields

Elsys and Avisto Eastern Europe

CREATED 2004/2007

- Advans Group companies

LOCATIONS

- Europe, Serbia, Belgrade and Novi Sad

KEY FIGURES

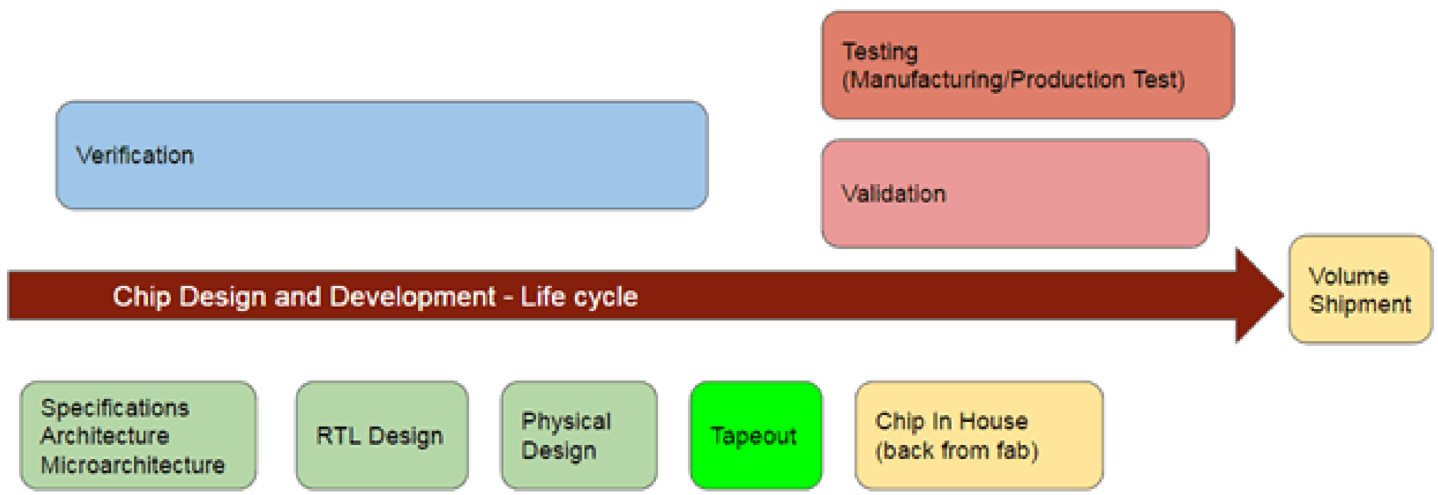
- Staff: 220 engineers
- Technical Open Space – 3000m2
- 7YoE
- Certifications – ISO9001, ISO14001, ISO27001, SR10
- Turnover – 11M€

CUSTOMER DESIGN CENTRES

- TI, INTEL, STM, MAXIM, SCHNEIDER, NOKIA

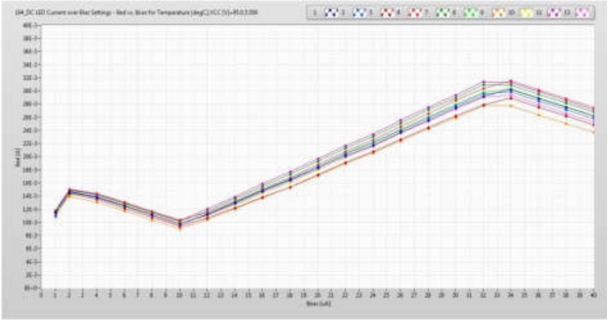
Post-silicon Validation and Characterization

- Post-silicon validation is the last step in the development of a semiconductor integrated circuit.



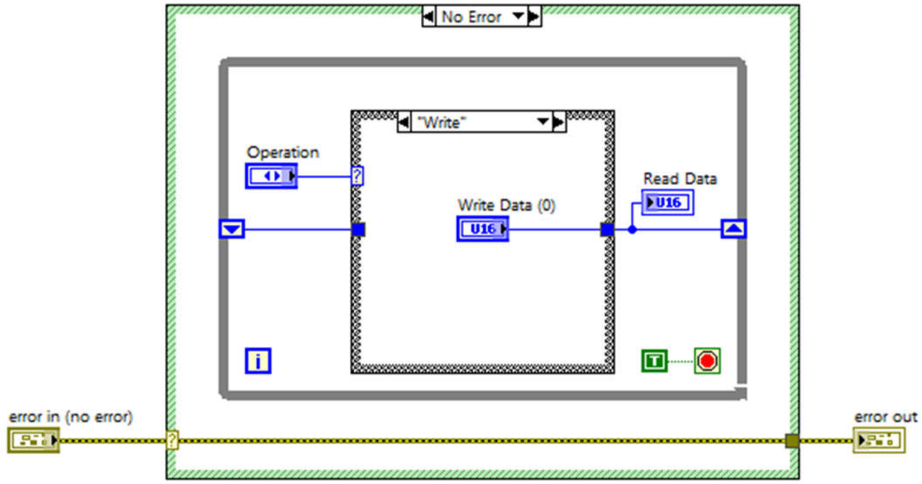
Project Flow

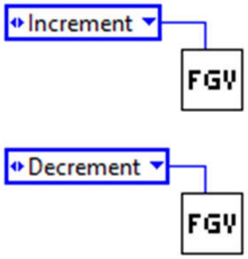
- Requirements capture
- Validation Plan Development
- Test Environment Development
  - Test PCB development
  - Instruments setup
  - Thermal chamber setup
  - Other electronic equipment setup
- Tests development (control of instruments, data acquisition, storage and analysis)
- Test report generation



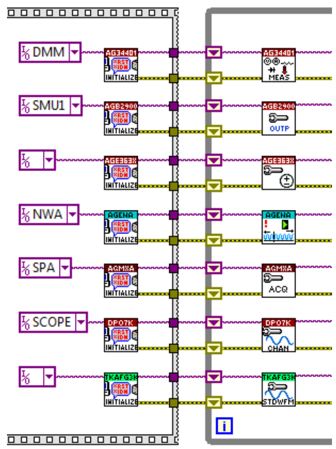
Too many instruments and resource names

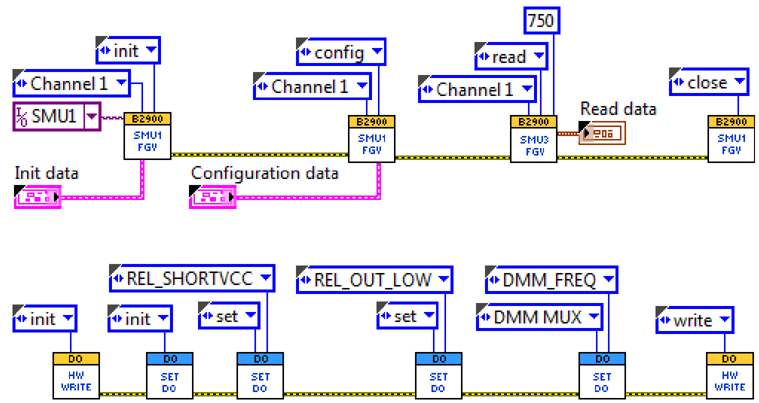
- For clear and clean code Function Global Variables were used
- Functional global variable is a non-reentrant VI that uses one iteration while loop with uninitialized shift registers to hold global data.

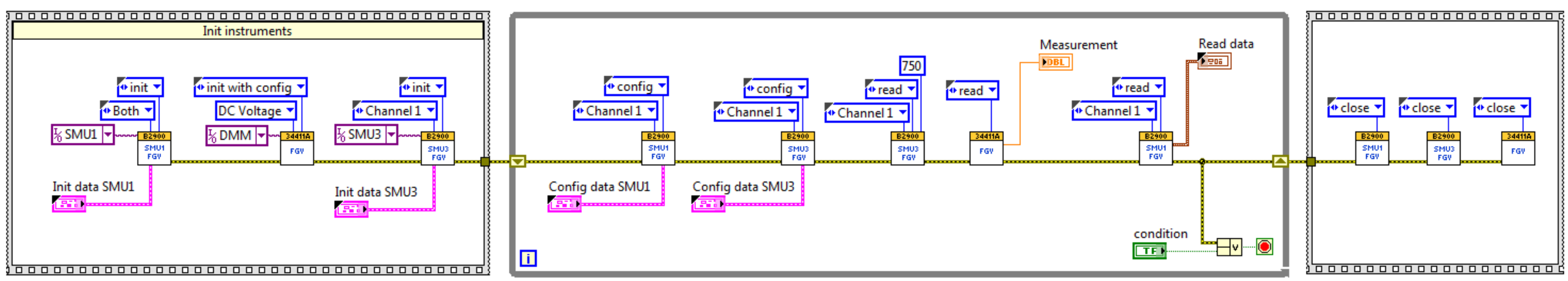




The Code looks clear







Scripts instead of Hard Coded

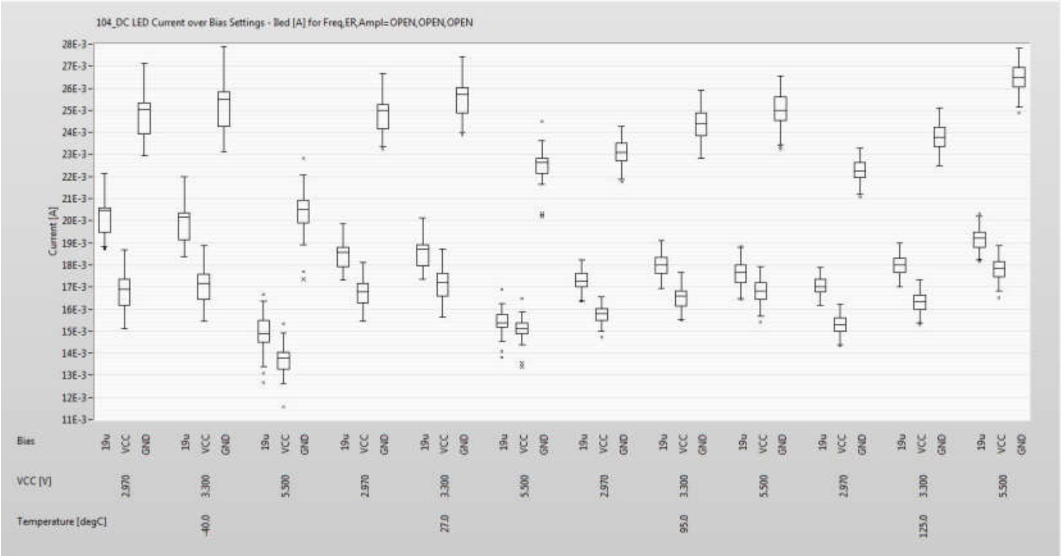
- Flexibility – changing the scripts instead of changing the code
- Loading files, parsing data and automatic actions in the application

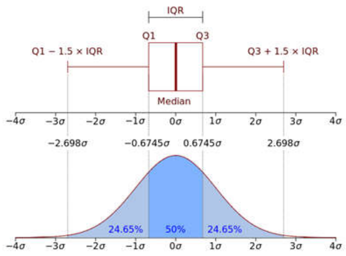
```
[Test1]
Name=Input Resistance
Number=101
Perform_Test=True
Number_Of_Parameters=2
Parameter_1_Name=T [deg C]
Parameter_1_Log=True
Parameter_1_Number_of_Values=4
Parameter_1_Value_1=-40
Parameter_1_Value_2=27
Parameter_1_Value_3=95
Parameter_1_Value_4=125
Parameter_2_Name=VCC [V]
Parameter_2_Log=True
Parameter_2_Number_of_Values=1
Parameter_2_Value_1=3.3
Using_Tables=False
Noise=False
Single_Write_Parameters_Number=5
Single_Write_Parameters_1=Measured Temp [deg C]
Single_Write_Parameters_2=Measured VCC [V]
Single_Write_Parameters_3=Icc [A]
Single_Write_Parameters_4=Rinp [Ohm]
```

```
-- Coil Test
-- Straight segment
REPEAT i 6
mcc write16 #i 1004 0 2
DELAY 100
mcc write16 #i 2106 1 1000
DELAY 100
mcc write16 #i 2106 2 -1000
DELAY 100
mcc write16 #i 2106 3 1000
DELAY 100
mcc write16 #i 2000 0 $7
DELAY 100
mcc read16 #i 2108 1
DELAY 100
--TEST Voltage of coil 1
CHK MIN 80 MAX 120 ERROR VOLTAGE OF COIL 1 VALUE OUT OF RANGE
mcc read16 #i 2108 2
DELAY 100
--TEST Voltage of coil 2
CHK MIN 65416 MAX 65456 ERROR VOLTAGE OF COIL 2 VALUE OUT OF RANGE
mcc read16 #i 2108 3
DELAY 100
--TEST Voltage of coil 3
CHK MIN 80 MAX 120 ERROR VOLTAGE OF COIL 3 VALUE OUT OF RANGE
DELAY 100
mcc write16 #i 2000 0 0
DELAY 100
END REPEAT
```

Custom report

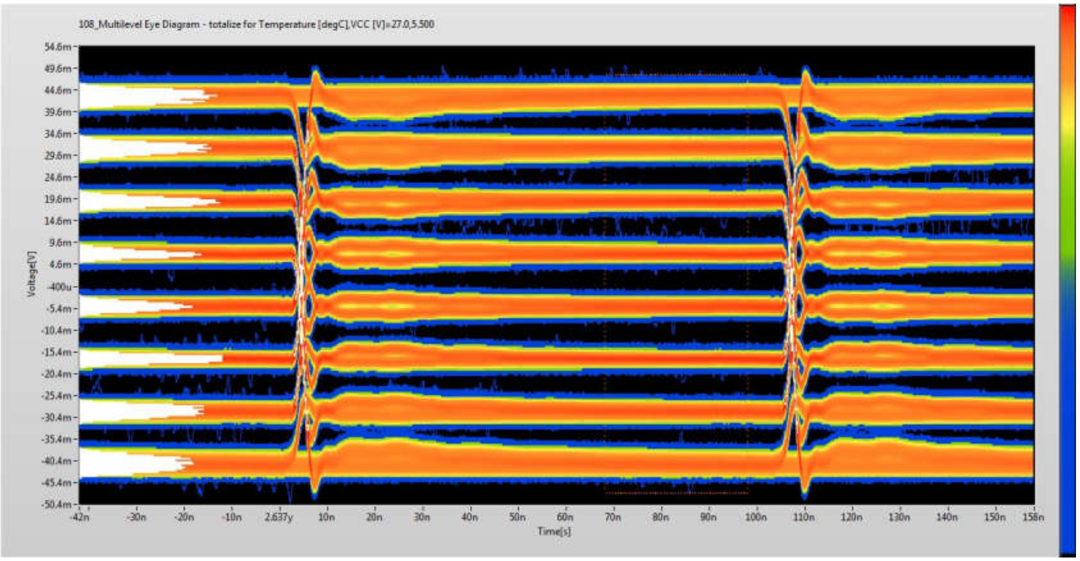
- The customer wanted the data to be presented with Boxplots
- Boxplot displays variation in samples of a statistical population
- Found a solution on ni site and modified it for our purposes





Modifying LabVIEW Toolkit

- NI LabVIEW Jitter Analysis Toolkit - analysis for standard NRZ signal
- Modified existing functions for PAM-8 multilevel eye diagram



Conclusions, Questions and Contact Details

- Competition's site: http://blsc.etf.rs/
- Elsys Eastern Europe: 3 or 4 internships during the year
- Scholarship (deadline for application is 10.11.2019.)
- Presenter's e-mail: aleksandar.popovic@elsys-eastern.com

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of the European Union

“New trends in biomedical data acquisition”

Milica Janković, Ass. Prof.

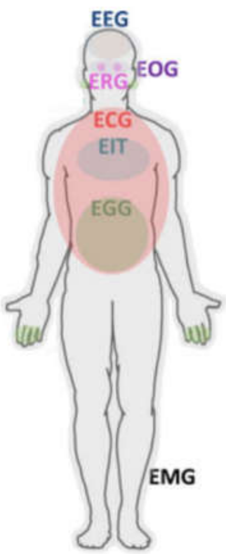
Research group for Biomedical Instrumentation and Technologies (BMIT)

University of Belgrade – School of Electrical Engineering

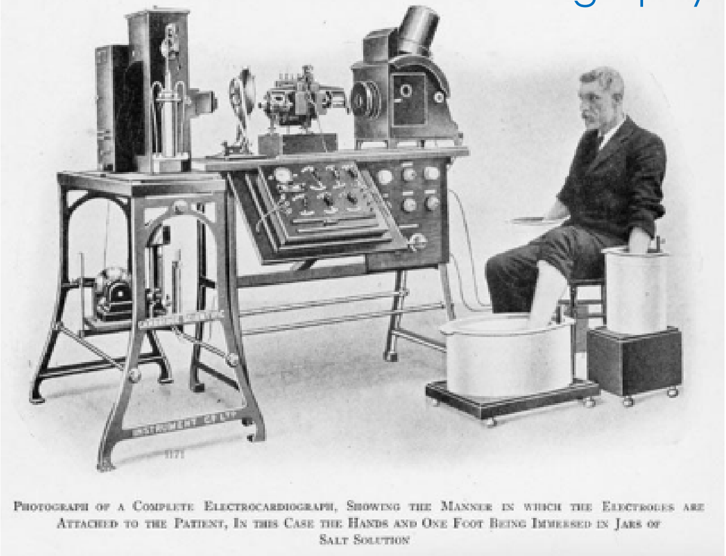
http://bmit.etf.bg.ac.rs/

Biopotentials?

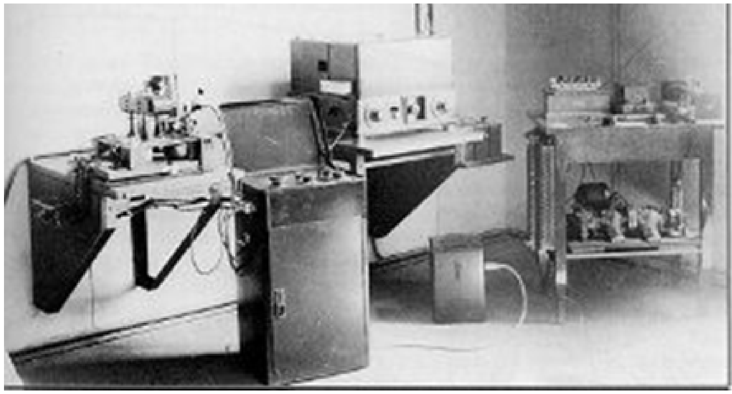
- Many organs (heart, brain, muscles…) produce electrical potentials, so called "biopotentials"
- "Action potential" is the biopotential of the cell membrane when the cell is excited
- Electrophysiological signals represent the sum of action potentials of individual cells



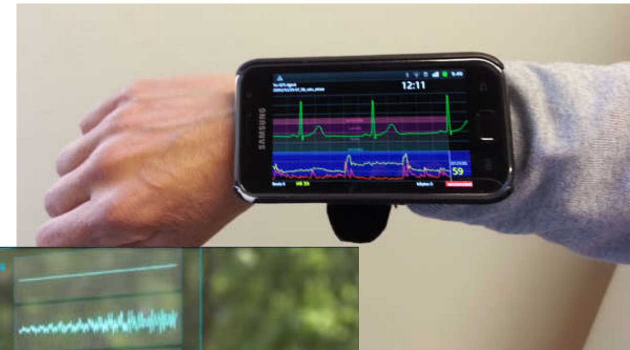
1903. - Electrocardiography

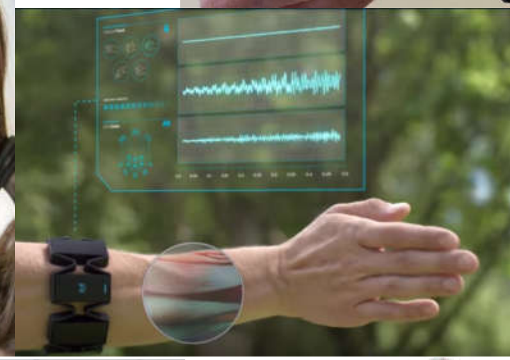


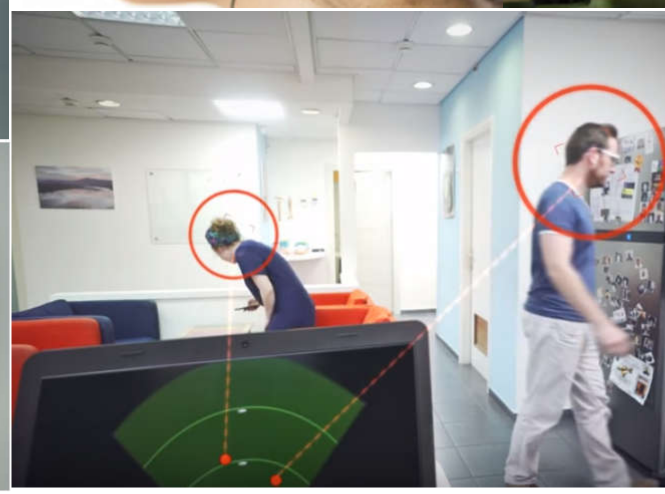
1929. - Electroencephalography



Today and future





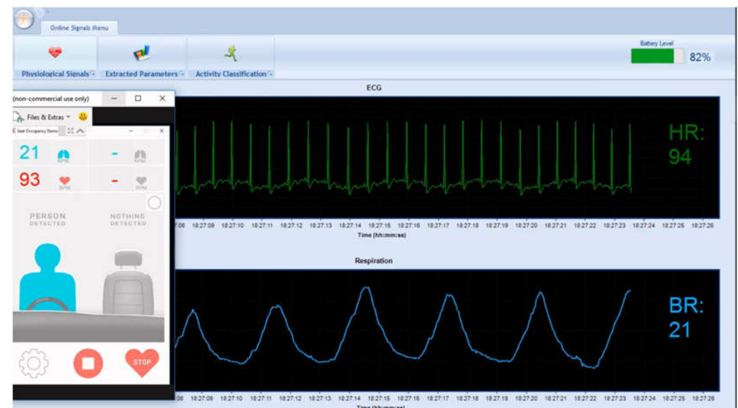


Today and future

In cooperation with Pylosophy faculty, University of Belgrade, Psychology Department

- Parameters immediately available
- Signals available on cloud
- Artificial intelligence

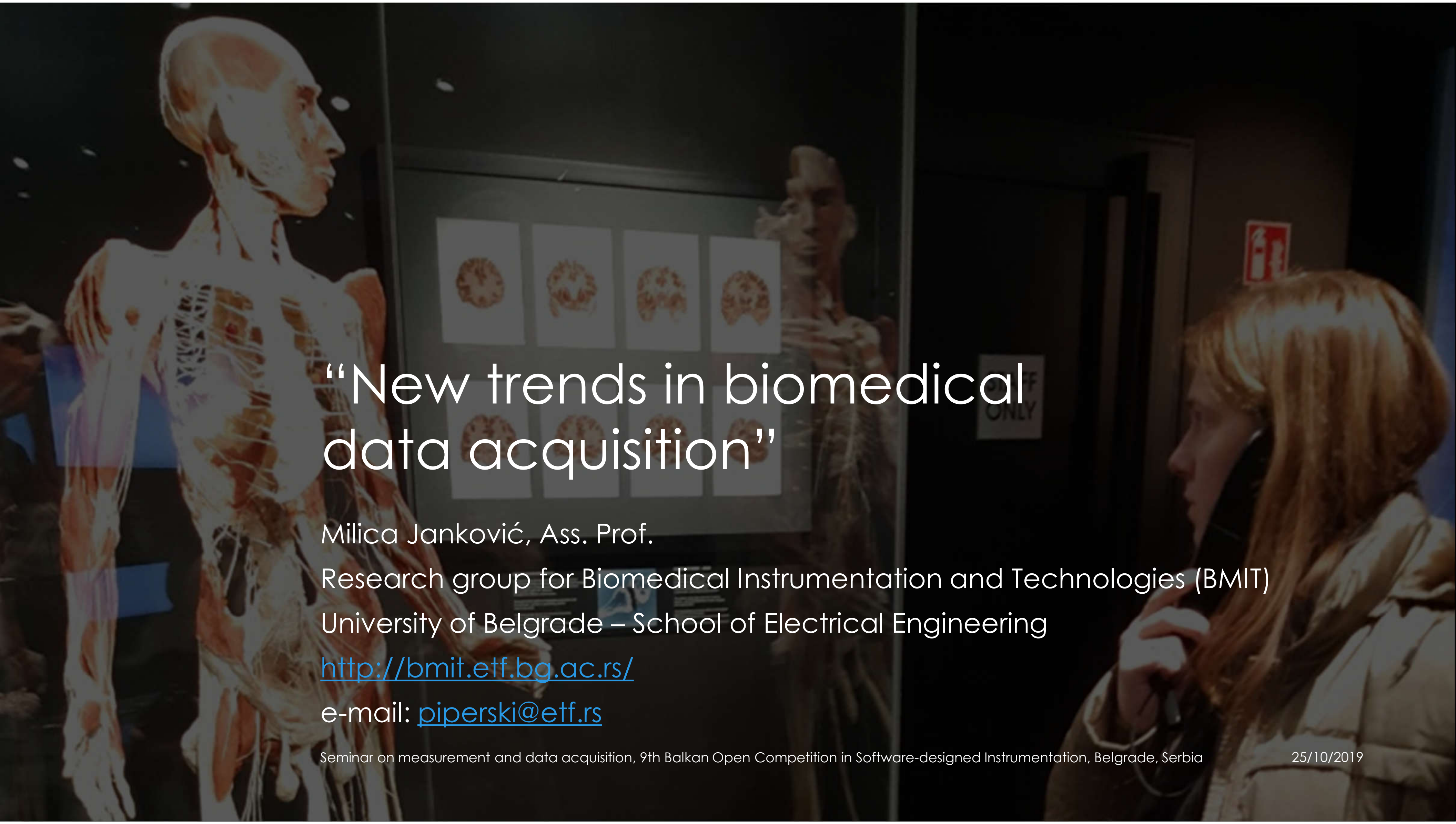
- Wearable technology
- New biosensors (biomaterials, dry sensors)
- Non-contact sensing
- Multimodality



NovelIC and ETF, HUDES project - Doppler-radar real-time monitoring using deep learning approach – comparison with reference Smartex system

"New trends in biomedical data acquisition"

Milica Janković, Ass. Prof.
Research group for Biomedical Instrumentation and Technologies (BMIT)
University of Belgrade – School of Electrical Engineering
http://bmit.etf.bg.ac.rs/
e-mail: piperski@etf.rs



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Can you see it?

The headphones are measuring my brain signals

Bogdan Mijović, mBrainTrain, Belgrade

mBrainTrain

- Active since 2014.
- The company is focused on developing technology for mobile brain recordings in real-life settings

mBrainTrain

- Our products are present in over 30 countries on 5 continents
- Smarting has helped generating more than a 100 scientific publications
- We actively collaborate with more than 60 scientific labs around the world

University of Oxford · Birmingham City University · Inria · Korea University · Fraunhofer · Universität Würzburg · Michigan State University · UCLA

University of California · Universitätsklinikum Tübingen · KU Leuven · University of Surrey · Goethe Universität Frankfurt am Main · DTU Technical University of Denmark · The University of New Mexico · Max-Planck-Gesellschaft

University of Toronto · UTS · Universität Konstanz · UC San Diego · Texas Tech University · CEU Universidad San Pablo · The University of Oklahoma Health Sciences Center · Mississippi State University

Measuring Mental Workload

OVER 80%

A huge percentage of accidents are due to human error (80% of air crashes, 94% of car accidents, more than 99% of accidents in factories)

It is due to mental overload, drop in focus and attention, tiredness

We are not able to track the mental state of the worker, detect the mental fatigue or mind wander and prevent it

NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

Mental Demand — How mentally demanding was the task?

Very Low — Very High

Physical Demand — How physically demanding was the task?

Very Low — Very High

Temporal Demand — How hurried or rushed was the pace of the task?

Very Low — Very High

Performance — How successful were you in accomplishing what you were asked to do?

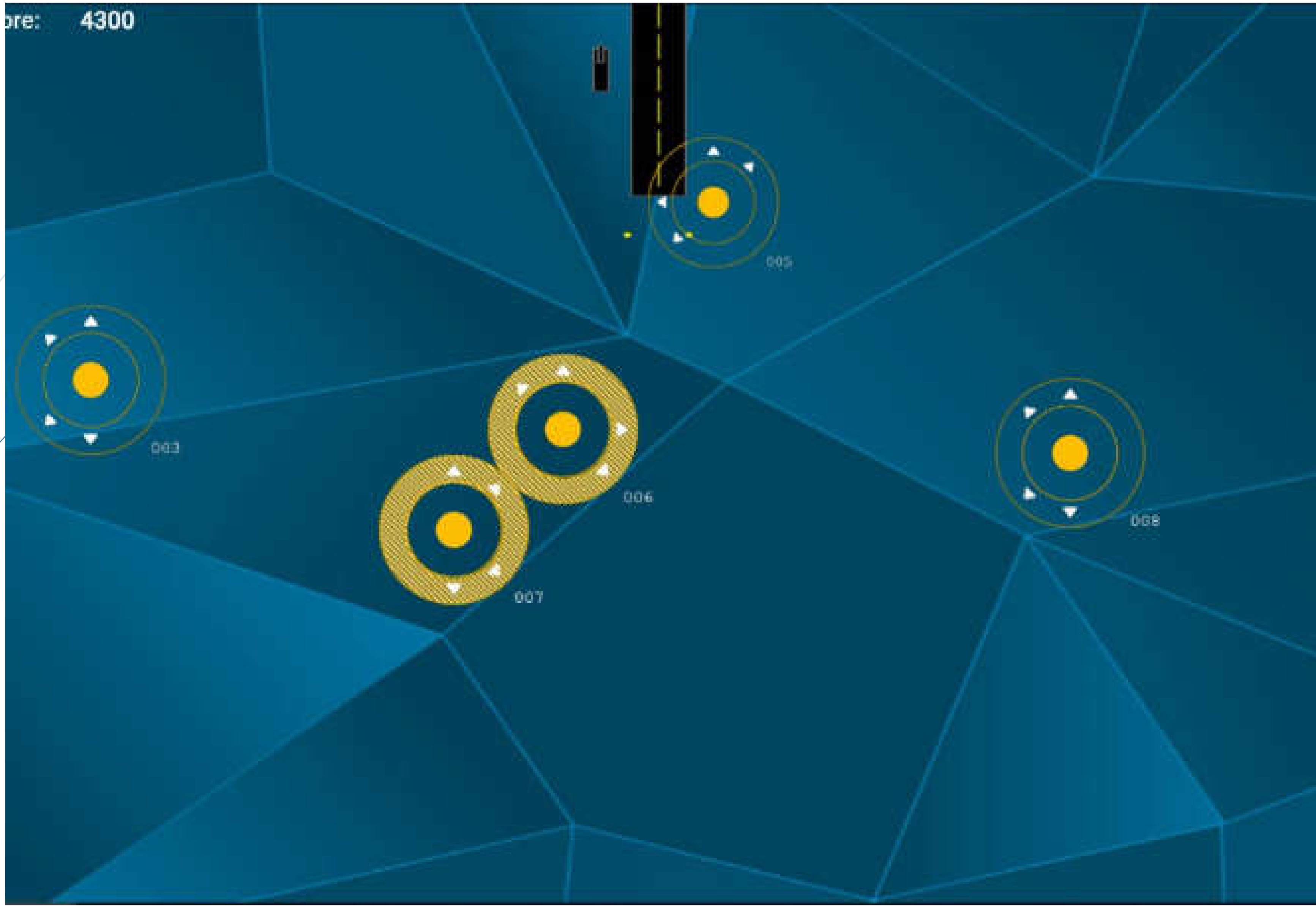
Perfect — Failure

Effort — How hard did you have to work to accomplish your level of performance?

Very Low — Very High

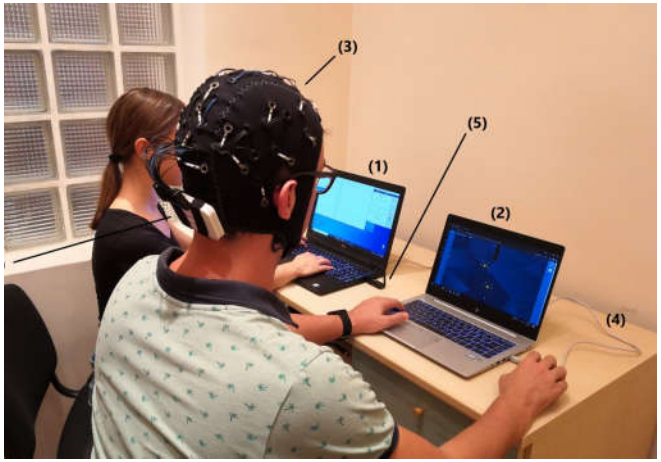
Frustration — How insecure, discouraged, irritated, stressed, and annoyed wereyou?

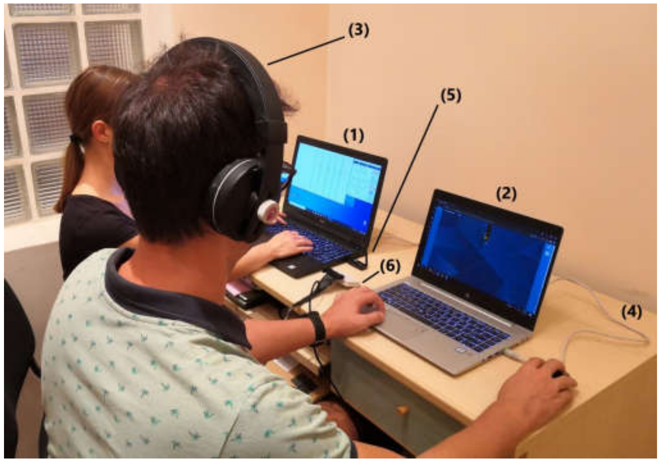
Very Low — Very High

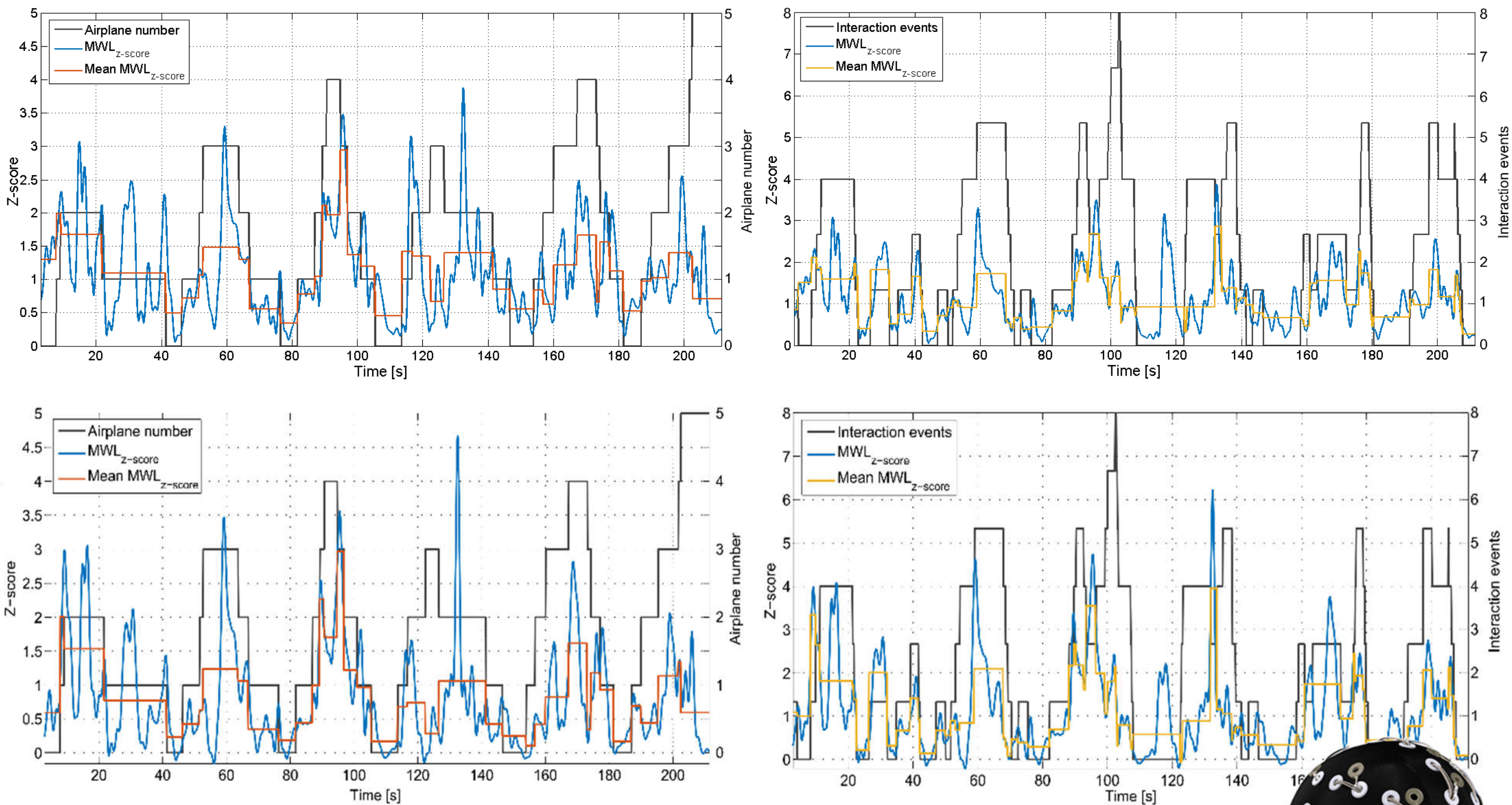

ore: 4300
005
003
006
008
007

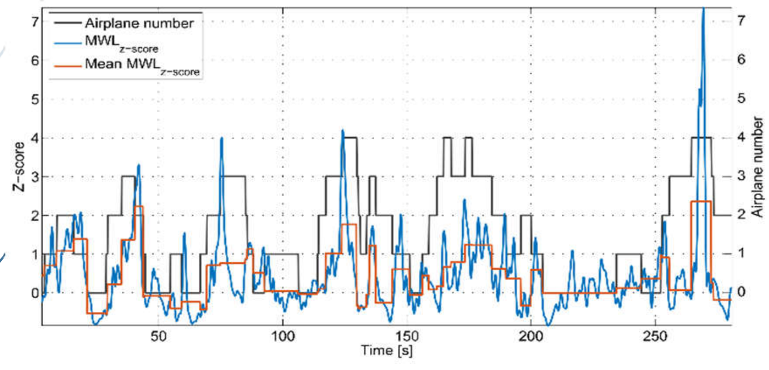
THE EXPERIMENT

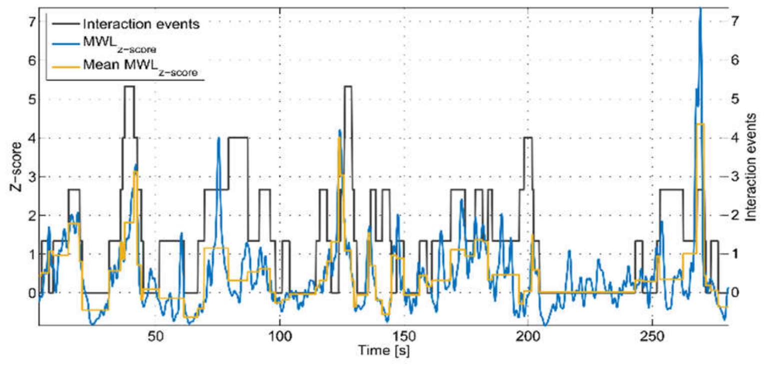
- (1) Acquisition computer
- (2) Task computer
- (3) EEG cap (smartfones)
- (4) Ethernet cable
- (5) Bluetooth modul
- (6) Smarting amp






Airplane number
MWL z-score
Mean MWL z-score
Z-score
Airplane number
Time [s]
Interaction events
MWL z-score
Mean MWL z-score
Z-score
Interaction events
Time [s]


Airplane number
MWL z-score
Mean MWL z-score
Z-score
Airplane number
Time [s]


Interaction events
MWL z-score
Mean MWL z-score
Z-score
Interaction events
Time [s]

Future Work

- Develop algorithms for automatic detection of mental fatigue based on mental workload
- Investigate how different changes in the work routine affect brain dynamics
- Investigate ways to react on mental fatigue in order to optimize for worker performance
- Work further on optimizing the recording equipment to better fit the workplace of interest.
- Develop passive BCI, a neuroadaptive technology capable od adjusting the automation level in respect to worker's mental state

Thanks!

Bogdan Mijović, mBrainTrain
bogdan@mbraintrain.com