



Fakulta rybářství
a ochrany vod
Faculty of Fisheries
and Protection
of Waters

Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice
Czech Republic



Institute of Complex Systems
Nové Hrady FFPW CENAKVA
University of South Bohemia
České Budějovice

Instruments for fish and water monitoring



Jan Urban, P. Císař, A. Bárta , P. Souček, M. Saberioon, A. Pautsina,
D. Bekkozhayeva, P. Urbanová, V. Bozhynov, A. Movchan
Biotechnology, Mevpis, Vodňany 2018



Maintenance, Management, and Optimization = Observe, Process, Control

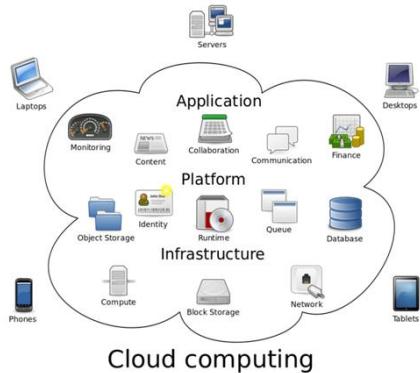
Cyber – physical systems

- smart
- autonomous
- independent
- network
- swarm

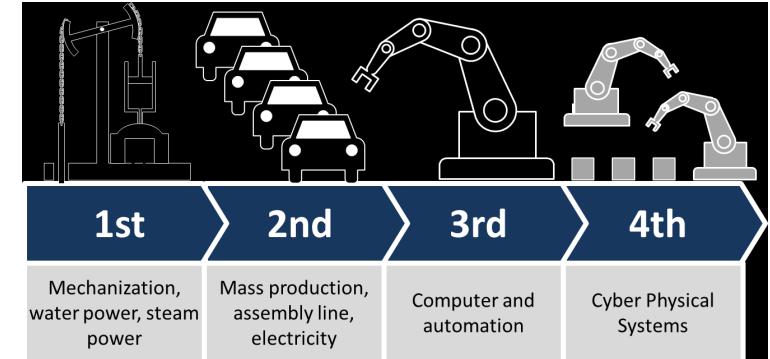
Internet of things

- digitization
- online

Cloud computing



- remote access
- device and location independence
- databases
- multitenancy
- performance monitoring
- security
- artificial intelligence
 - signal processing and analysis
 - neural networks
 - multi-agent modeling



Cybernetics, mechatronics, informatics, biophysics, **aquaculture, and water protection**.



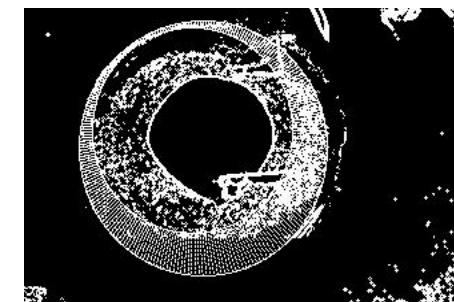
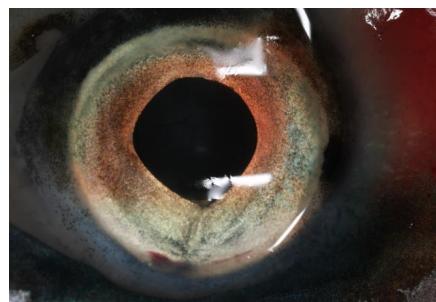
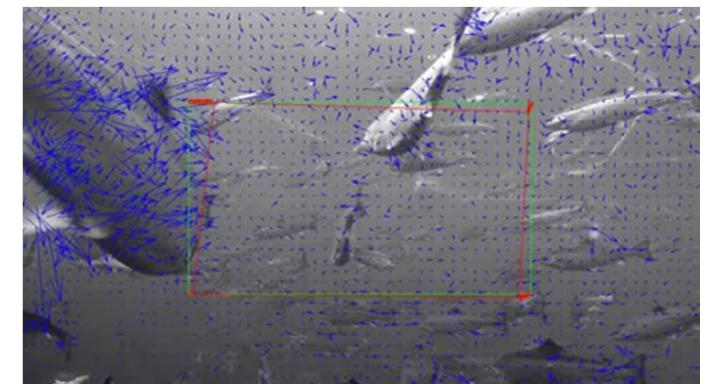
Biomonitoring and Biometrics

Why biomonitoring?

- behavior study
- living sensors
- activity and welfare information
- feeding, disease, pollution detections
- optimization of cultivation process
- reduce financial loss, labour intensity, analysis cost and time,
- early warning systems

Biometrics

- noninvasive
- robust statistic
- analysis on individuals
- iris detection
- patterns recognition



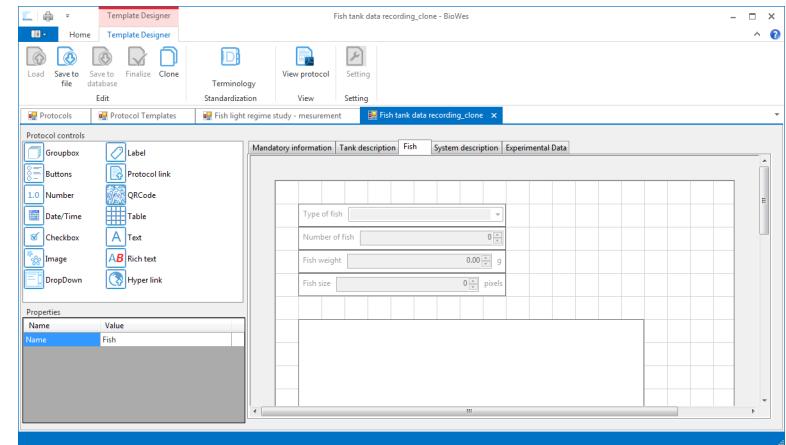


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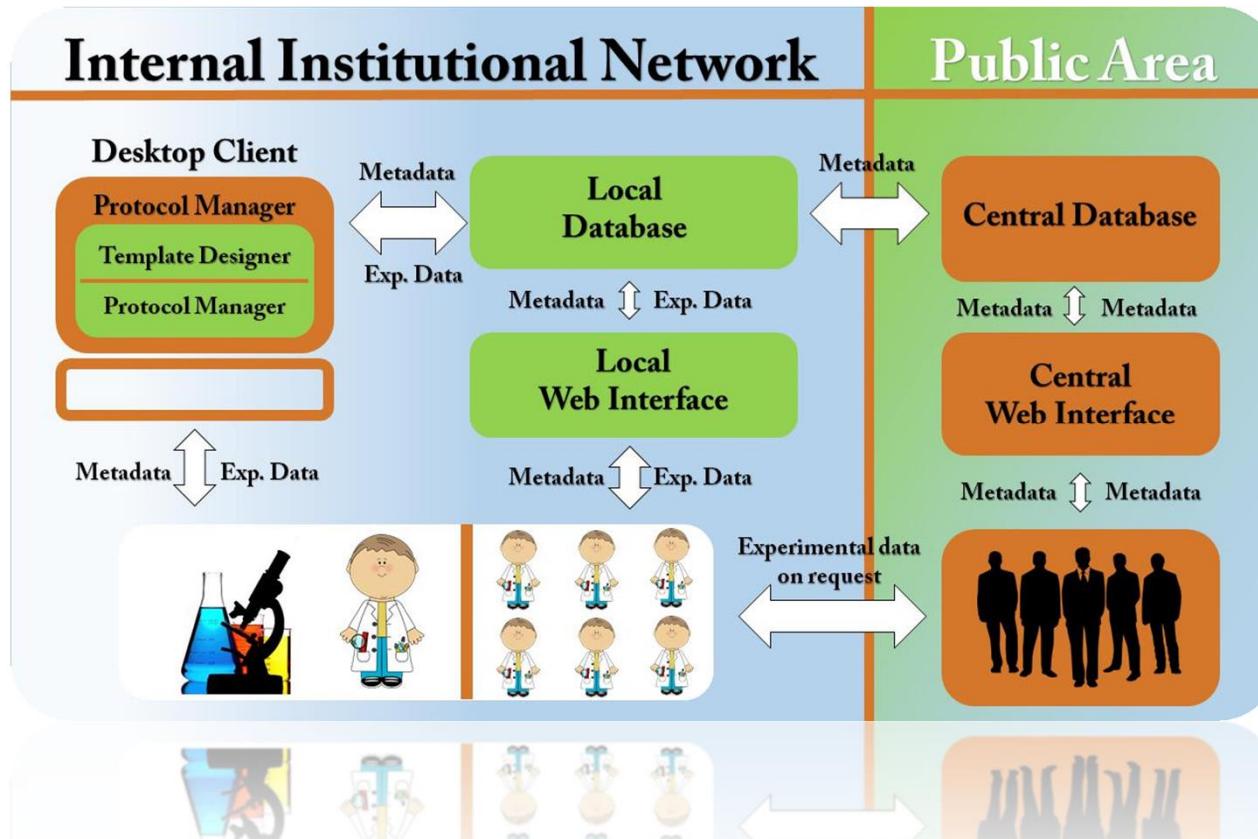
bioWes

- Scientific data and metadata management platform
- Support from protocol design to sharing
- Electronic protocol
- Standardization, ontology supports
- Communication with devices – plug-ins
- Protocol evolution
- Data processing/visualization modules



Internal Institutional Network

Public Area



<http://www.biowes.org>

T A
Č R
dataPartner

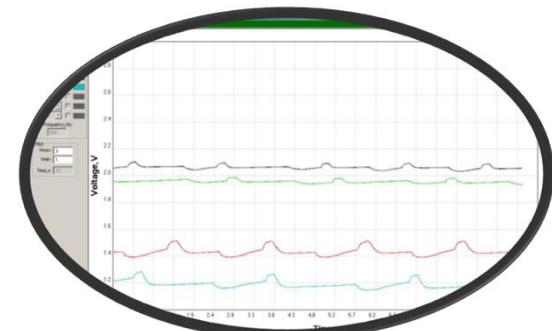
AQUA
EXCEL
Technology Agency of the Czech Republic



Biondication

Crayfish monitoring

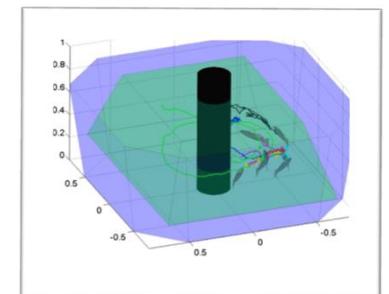
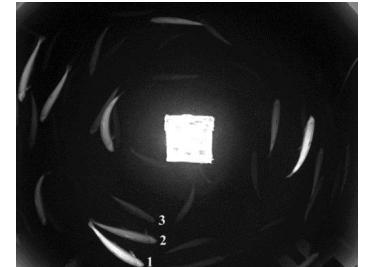
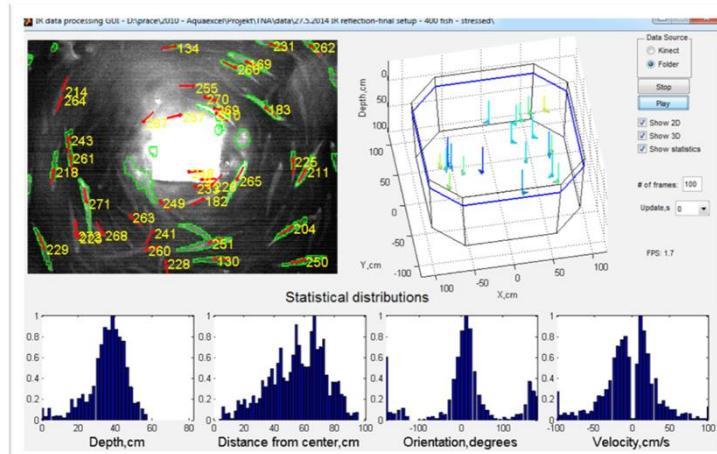
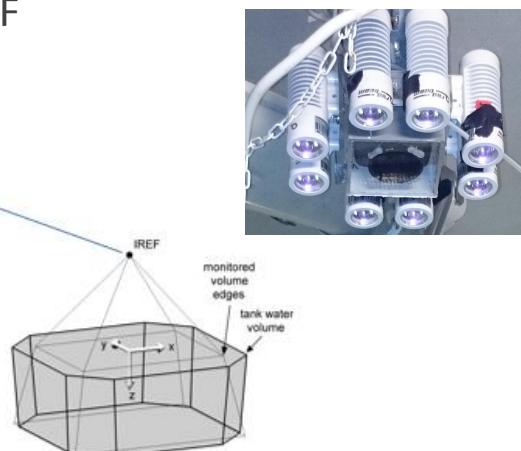
- heart beat analysis
 - sensitive bioindicator
 - objective information about welfare
 - water quality monitoring
 - abnormal behavior detection
 - early warning system
 - automatic system
-
- water treatment stations
 - breweries





Fish Behavior

- Automatic noninvasive fish localization application in aquaculture
- Understanding of fish physiology - how the fish reacts to the different stimuli
- Feeding optimization – feeding behavior
- Fish activity
- Fish exercising – fish health/meat quality
- Optimization of fish cultivation conditions
- Analysis of fish state – disease detection
- Abnormal behavior
- Bioindication – changes of the environment (pollutions)
- IREF



Kinect for Windows v2 Sensor



Patents – Císař, P., Saberioon, M., Kozák, P., 2016. Method for detecting and visualizing spatial trajectories of aquatic animals and devices for carrying out this method. Industrial Property Office, Praha, patent no. 305982.



Application for color analysis

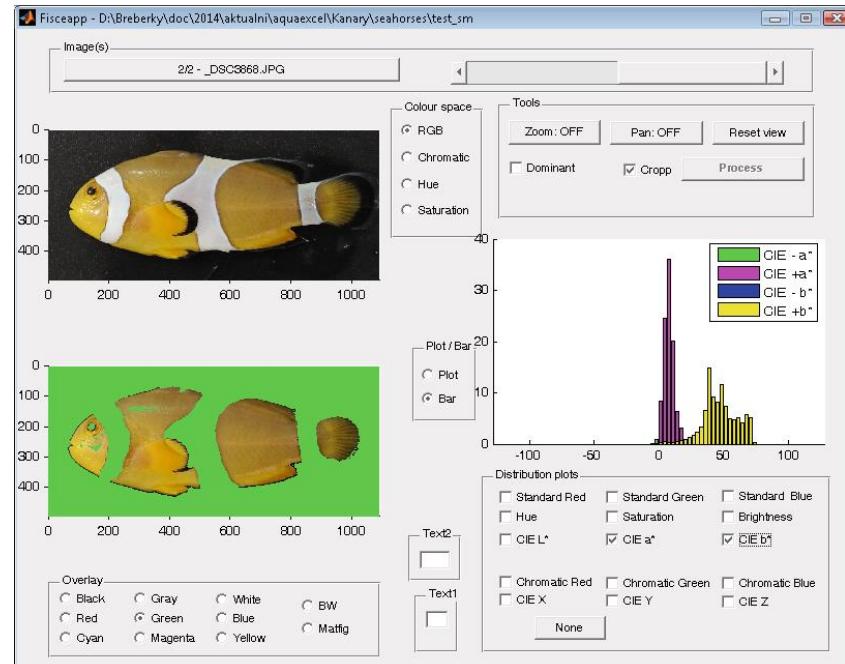
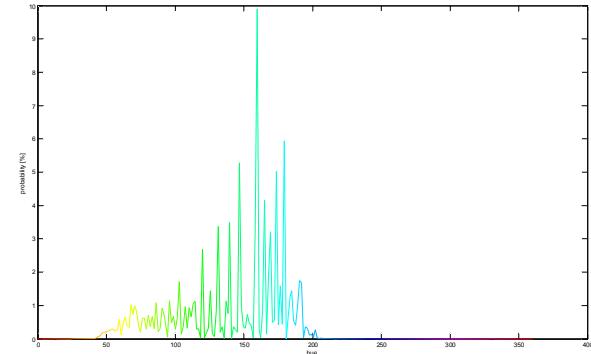
Photo chamber – standardized light conditions

Multispectral imaging

Controlled by microPC

Statistical analysis

IoT



WHOLE SET				
	Mean	Median	Mode	Standard deviation
RGB - Red	115.3	93.0	72.0	54.7
RGB - Green	88.3	70.0	54.0	45.5
RGB - Blue	35.9	34.0	32.0	16.7
HSV - Hue	36.1	36.7	42.4	7.6
HSV - Saturation	65.0	63.9	49.8	13.8
HSV - Brightness	45.2	36.5	28.2	21.5
L*a*b* - CIE L*	38.8	31.6	23.7	19.2
L*a*b* - CIE a*	7.3	7.5	7.5	3.2
L*a*b* - CIE b*	31.7	23.6	13.6	18.8
U*Ch - Lightness	45.0	36.3	28.1	21.5
U*Ch - Chroma	37.8	32.0	26.5	18.1
U*Ch - Hue	24.5	26.7	30.9	8.9



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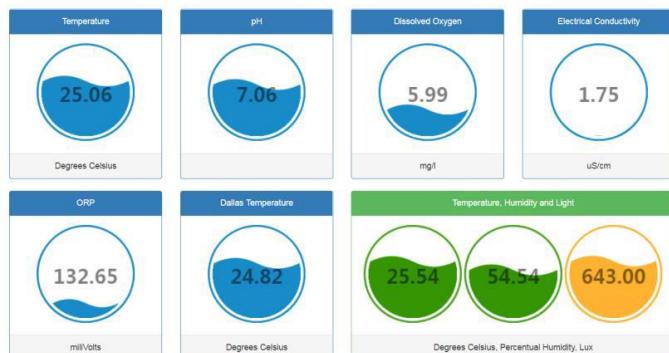
IoT device: Probes – Atlas Scientific, Dallas, PRC.
Hydroponic – EC, Ph, t.
Aquaculture – Ph, DO, t.
Aquaponic – EC, Ph, DO, t.
Extended + humidity, lux, ORP.



MicroPC – RaspberryPi,

LAN, Wifi

Software Client – User friendly,
Cloud solution,
Calibrations
History
Email alert





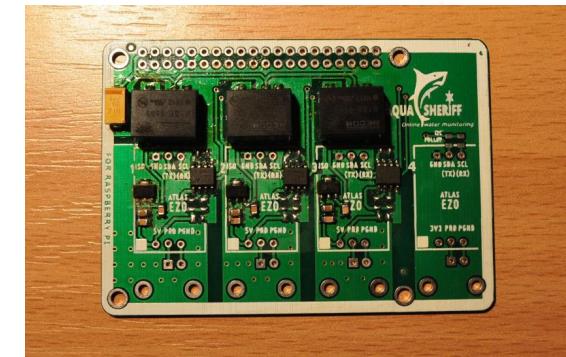
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Commercialized via Transfer technology office of the USB,
registered name (CZ).

Innovations 2019: Relays control,
micropumps,
UPS,
GSM alarm,
LoRaWAN
boards,
more probes,
outdoor.



www.aquasheriff.eu

- Trends in Online Biomonitoring, A. Bárta, P. Souček, V. Bozhynov, P. Urbanová, D. Bekkohayeova, IWBBIO 2018, Granada, Spain.
- Automatic Multiparameter Acquisition in Aquaponics Systems, A. Bárta, P. Souček, V. Bozhynov, P. Urbanová, IWBBIO 2017, Granada, Spain.
- Biomonitoring and water quality, Bozhynov V., Urbanová P., Bárta A., Souček P., Urban J. Štys D., FBFW 2017, CB.



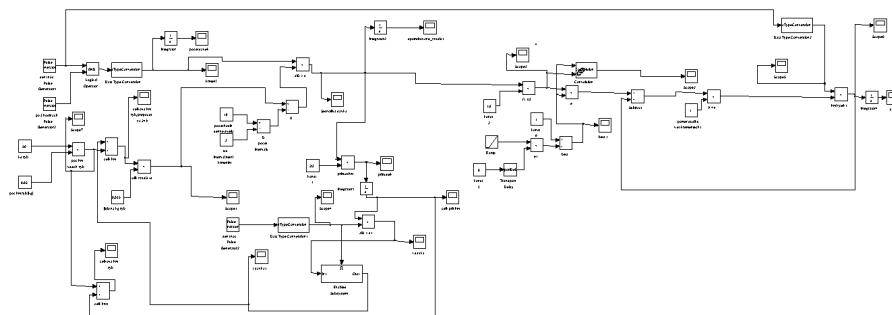
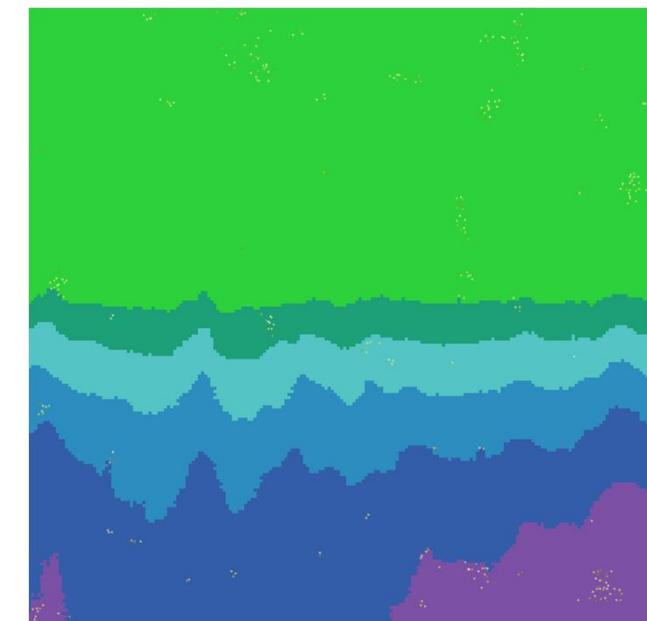


Conclusion

- Biotechnology has wide field in aquaculture and water protection.
- IoT, microPC, automatization, and cloud solutions are applicable and beneficial:
- Noninvasive, welfare, optimization, early warning systems.
- Solutions for biomonitoring, colormetry, water quality monitoring.

Future:

- Feeding and disease control
- Individuals biometric
- ODE and multi agent modeling
- Environment and fish behavior predictions
- Ras and aquaponic simulations and control
- Spectrophotometry and aquaphotonics
- Automatic sampling
- Dron solutions





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Acknowledgement

- Organizers of Biotechnology 2018
- South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses (CZ.1.05/2.1.00/01.0024)
- CENAKVA II (project LO1205 with a financial support from the MEYS under the NPU I program).
- TAČR TG03010027 01_05
- TAČR TG03010027 01_11
- TAČR TG03010027 02_23
- SGS-2016-039
- GAJU 017/2016/Z.

...and for Your attention



bioWES



T A
Č R
Technologická
agentura
České republiky