IARIA

The Fifth International Conference on Advances in Sensors, Actuators, Metering and Sensing

ALLSENSORS 2020

November 21, 2020 to November 25, 2020 - Valencia, Spain

Panel on
Digital Processing and Services
Topic: Sensing and Digitalization in Societal Transformation

Paulo E. Cruvinel, Chair

Embrapa   ufscar

Panelists

Roger Tilley, Sandia National Laboratories, USA

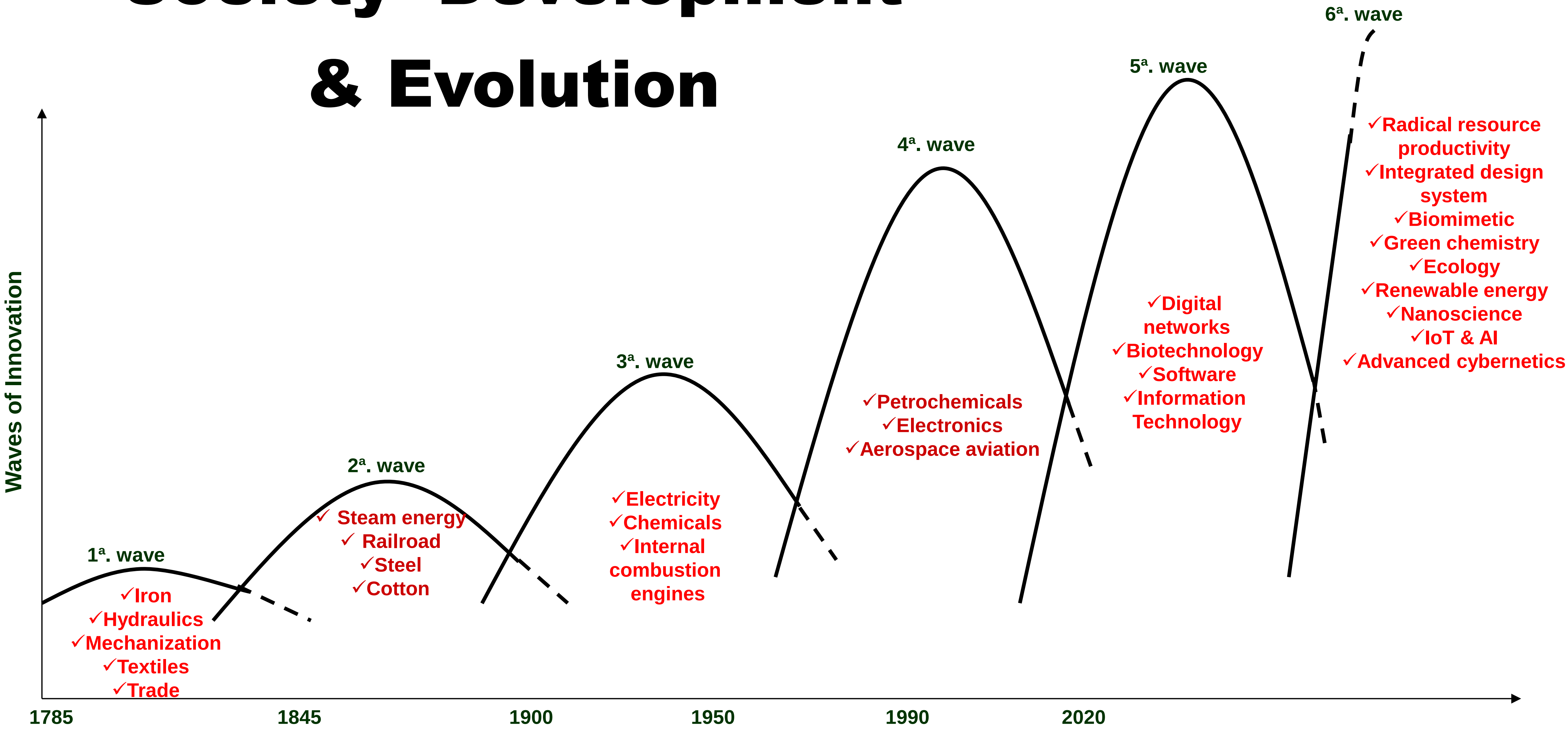
Arian Rajh, University of Zagreb, Croatia

Niels Frederik Garmann-Johnsen, University of Agder, Norway

Lorena Parra, Universitat Politècnica de València, España

Mojtaba Ghodsi, University of Portsmouth, UK

Society` Development & Evolution



Roadmap for Digital Processing and Services

- Integration of people, processes, and insights to re-engineer the products, services and experiences for life quality based on sensing and digitalization in societal transformation, innovation, technologies, and strategies to optimize business outcomes & models;

- As society rush headlong towards a digital future, there is a growing consensus that the digitalization needs to be subjected to continuous digital evolution and customization;

Roadmap for Digital Processing and Services

- The new society of organization needs to develop digital agendas in line with their objectives and operational requirements;

- With traditional systems relegated to providing back office efficiencies and legacy programs lacking the flexibility to fully exploit voluminous data (BigData) to evolve digitally by stripping off their stiff corset of standard software and start adopting personalized, multifunctional platforms;

Roadmap for Digital Processing and Services

- Cultivating an ecosystem guided by digital fundamentals is the cornerstone of digitalization. Increased collaboration between technology providers, IT service providers;

- A key thrust is developing a digitalization stratagem that includes an organization’s digital strategy, business objectives and models, as well as IoT and cloud computing.

Roadmap for Digital Processing and Services

Digital evolution is transforming business and organizational activities, processes, competencies, models, and life.

Digital Interactivity

Digital Processing and Services are aligning with the changing dynamics of customer expectations triggered by IoT technologies to create digital enablement and engaging experiences, in areas such as:

- agricultural sensing;
- building immersive engagement;
- building interactive engagement;
- crafting the right experience design;
- crowd sensing;
- identifying new lines of customer reach;
- life care;
- pollution sensing;
- rewriting customer experience;
- spatial sensing;
- traffic sensing;
- vital signs;

… among others!

User Digital Experience Design

Organizing new digital concepts to explore potential solutions to avoid failures in business outcomes, i.e., based on the advanced use of best practices, circular economy and connectivity in between human being and institutions.

- delineating;
- harmony designs,
- taxonomies;
- semantics;
- architecture;
- prototyping;
- wire-framing;
- interfacing & interaction.

… among others!

Digital Content

In today’s digital world, creating content should be a top goal in order to increase more inbound traffic in websites

- Making use of sensing and the IoT systems;
- Making multiple utilization of content;
- Making the content build based on results & visibility;
- Utilizing several different mediums.

Commerce Solutions

Solutions for online Ecommerce business are in the context of digital processing and services

- channels and network;
- marketplace;
- mobile Commerce;
- wholesale and Subscription Commerce;
- end-to-end solution;
- sales-enabling solutions;

… among others!

Digital Automation

Digital Automation is and alternative to traditional automation approaches like Application Programme Interfaces' (APIs). The technology accesses systems using the user interface of applications enabling rapid 'virtual' integration to autonomously execute business processes with human exception management. Today one can automate any business process which is executed in one or more software systems and uses inputs in digital format.

- Operations and decisions making based on data-driven and modelling, as well as embedded systems.
- The right mix of technology components and automation solution has become a powerful way to deliver outcomes, accuracy, enhancing, and productivity.

Thank you for the attention!

Panellist Position

Sensing and Digitalization in Societal

Arian Rajh, HALMED and University of Zagreb, Croatia/EU arian.rajh@halmed.hr

- Societal/social transformaton
- Digitlaization
- Sensors

→ Digitalization and the use of sensors transform our societies

PANEL ON DIGITAL PROCESSING AND SERVICES

SENSING AND DIGITALIZATION IN SOCIETAL TRANSFORMATION

Arian Rajh, Ph.D., Assoc. Prof.
Agency for Medicinal Products and Medical Devices of the Republic of Croatia
Faculty of Humanities and Social Sciences, University of Zagreb

IARIA

HALMED
Agency for Medicinal Products
and Medical Devices of Croatia

SENSING AND DIGITALIZATION IN SOCIETAL TRANSFORMATION

- Societal/social transformation
  - narrower meaning
    - gaining social status which differs from the one's predecessors
  - wider meaning
    - change of society in numerous ways
    - "Social transformation represents qualitative and quantitative change in all aspects of life…" (Rabie M. (2013) Social Transformation. In: Global Economic and Cultural Transformation. Palgrave Macmillan, New York)
  - meaning which combines previous two
    - "Social transformations through social inclusion and social innovation are at the crossroad of all of UNESCO's activities, with a particular focus on those who are vulnerable and disadvantaged and excluded." (UNESCO's MOST Programme, https://en.unesco.org/themes/social-transformations)
    - wider=innovation and individual=inclusion

SENSING AND DIGITALIZATION IN SOCIETAL TRANSFORMATION

- Digitalization
  - "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to digital business." (Gartner, https://www.gartner.com/en/information-technology/glossary/digitalization)
  - Digitalization changes business, activities, organizations…
- Sensors
  - gaining stimulus and information via devices, without contact or human observation
  - implementation in industry, sport, medicine, agriculture, daily activities

SENSING AND DIGITALIZATION IN SOCIETAL TRANSFORMATION

- Digitalization and the use of sensors transform our societies in numerous ways
  - smart mobile devices/wearables + IoT+ Big Data in the health domain, sport domain, defense domain, agriculture, leasure and so forth

SENSING AND DIGITALIZATION IN SOCIETAL TRANSFORMATION

- Possible scenarios:
  - growth of information as such and its potential
  - growth of automation
  - reduction of routine in business and daily activities
    - increasing productivity, removing unnecessary actions, and releasing more time for creative work and satisfied life
    - gaining competitive advantage without affecting people's lives in above mentioned sense
- How to foster and direct this transformation in the desired and required or needed ways?
  - to be focused on the individual and the wider impact when redesigning a process
    - benefit for the process and organization
    - benefit for the people and environment

THANK YOU!
Questions:

arian.rajh@halmed.hr

https://www.researchgate.net/profile/Arian_Rajh
https://orcid.org/0000-0001-7567-7495

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Panel 1

Theme: Digital Processing and Services

Topic: Sensing and Digitalization in Societal Transformation

(crowd sensing, agricultural sensing, livestock, traffic sensing, pollution sensing, spatial sensing, vital signs, sensitivity, and accuracy, etc.)

Digital World 2020

Panellist Position

Low Cost Sensors for Monitoring the Fish Farming Activity

Lorena Parra, Universitat Politecnica de Valencia & Instituto Madrileño de Investigación y Desarrollo Rural, Agrario y Alimentario, Spain loparbo@doctor.upv.es

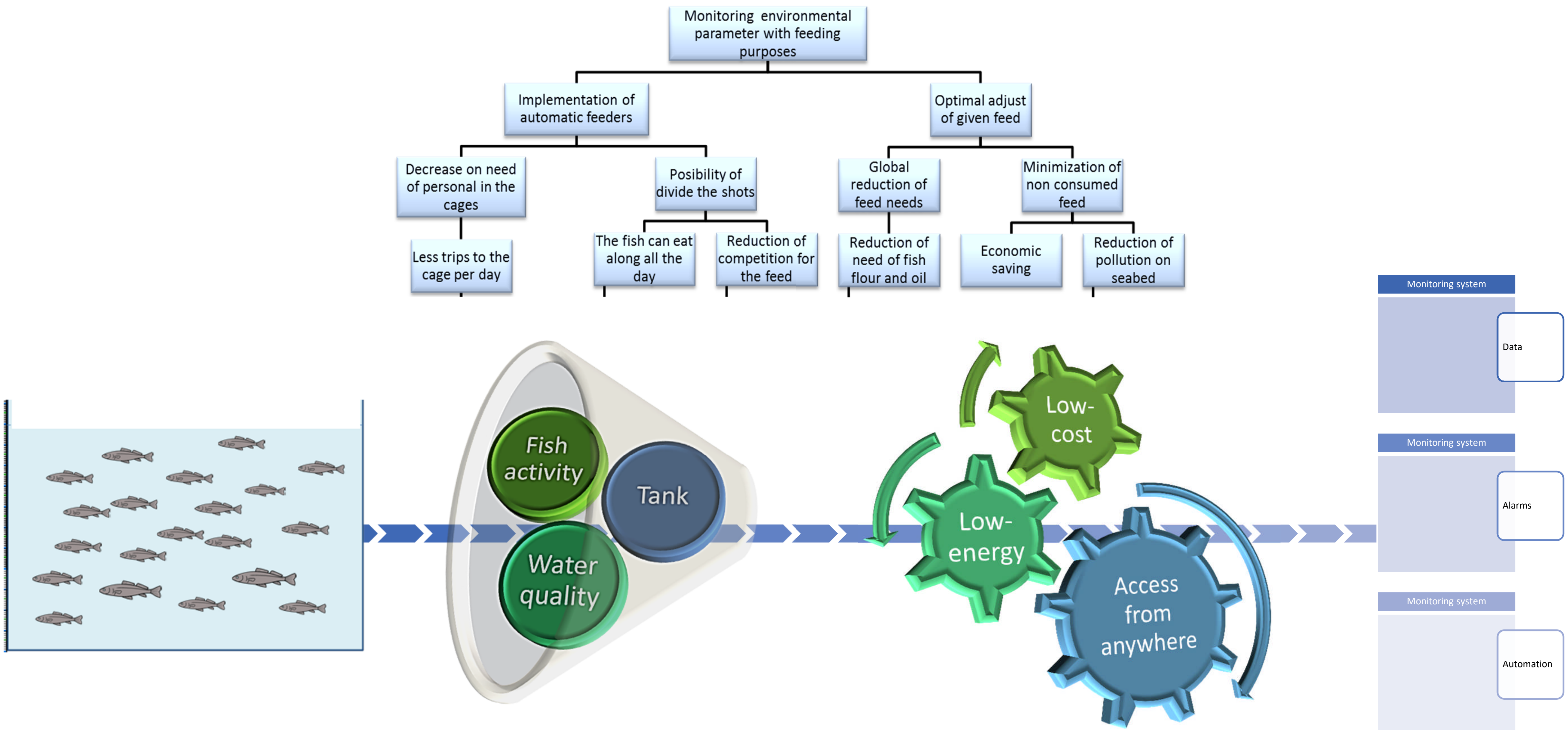
- We are in the edge of the technological revolution in many sector
- Despite the advantages of new technologies, few primary sectors are including them in their activity
- Aquaculture is one of the most challenging activities to implement WSN
- The high cost of commercial sensors is one of the main barriers
- The requirements of maintenance and periodic calibrations are another encountered problem

→ Low Cost sensors that ensures the required accuracy must be developed

→ New sensors to monitor the position of fishes in the tank are need to estimate the fish needs

→ The first step is to integrate this sensors in fish tanks

What will offer the WSN to fish farming activity?



Sensors for water quality

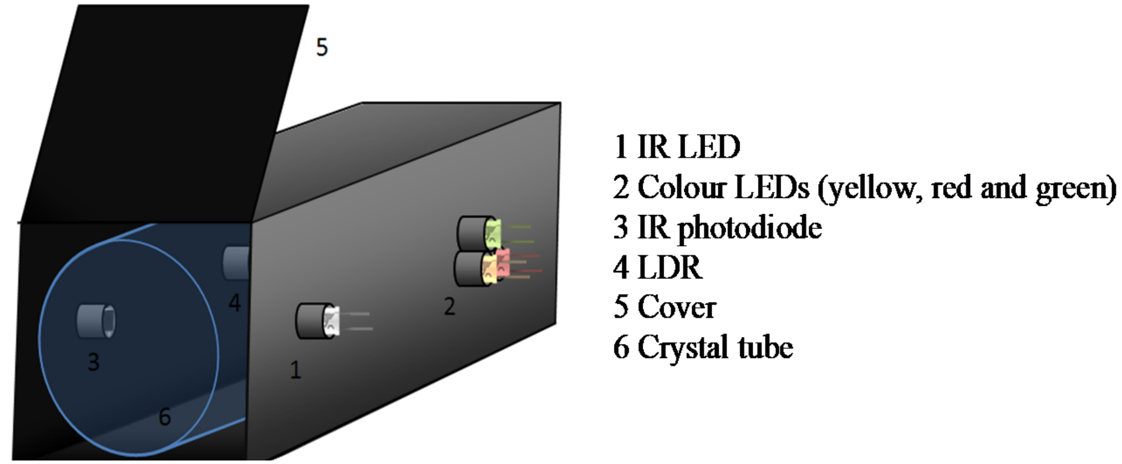
Motivation: Turbidity monitoring

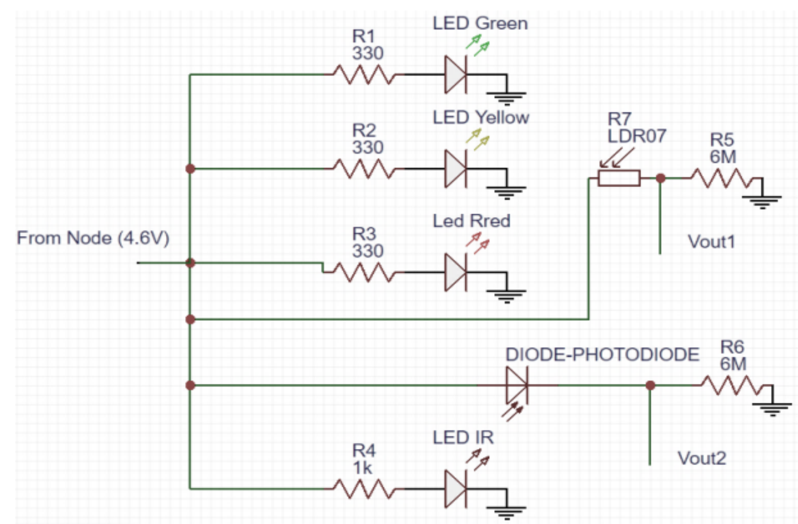
Task: Quantify and characterize the turbidity

Objectives:

1. Evaluate if low cost system can be used formed by four LEDs (RGB + IR)

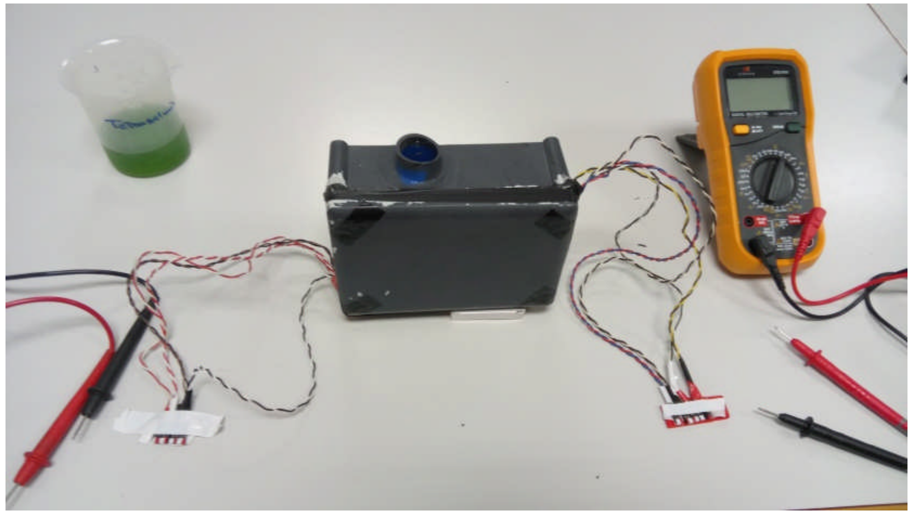
2. Identify differences between turbidity sources (sediments and phytoplankton)





Parra, L., Rocher, J., Escrivá, J., & Lloret, J. (2018). Design and development of low cost smart turbidity sensor for water quality monitoring in fish farms. *Aquacultural Engineering*, *81*, 10-18.

Sensors for water quality



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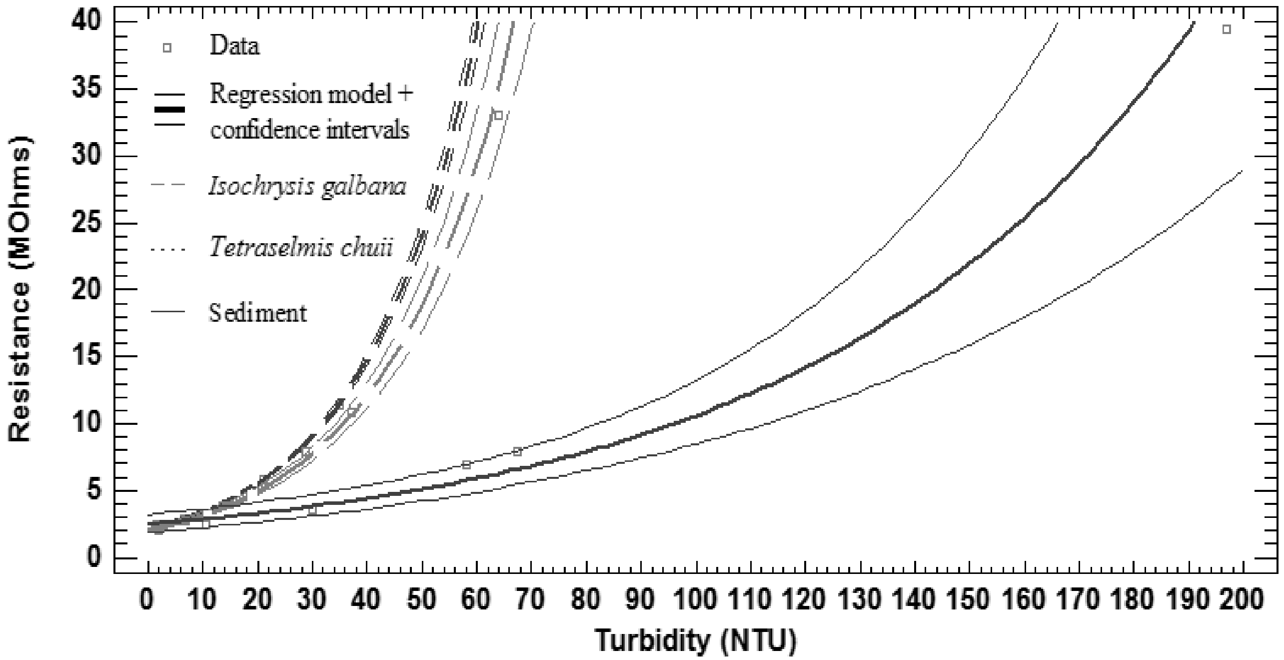
RED + IR LEDs →



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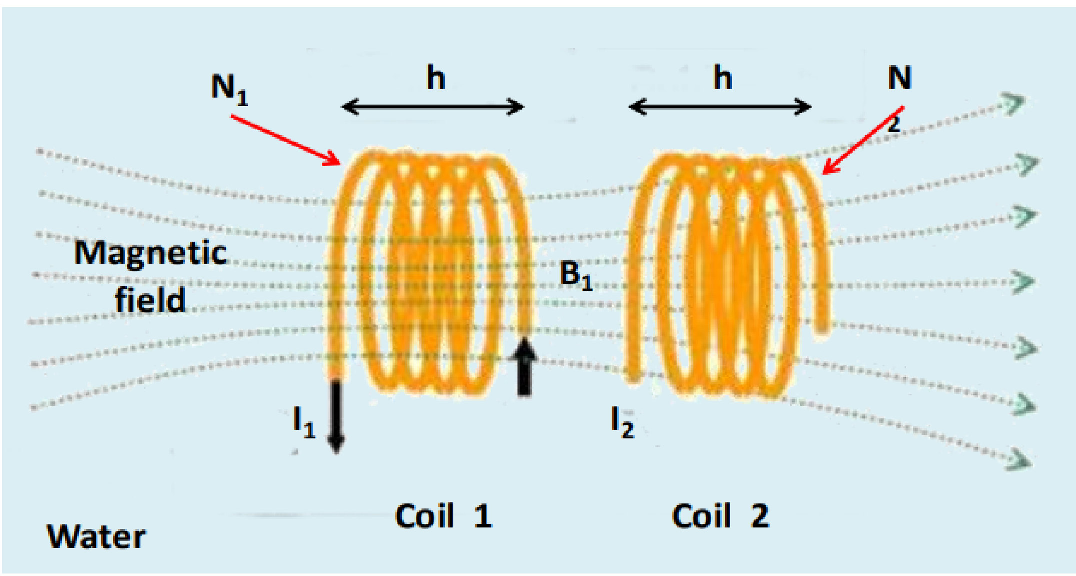
Motivation: Conductivity monitoring

Task: Estimate the conductivity with non-contact sensor (to avoid biofouling)

Objectives:

1. Evaluate if copper coils can be used to measure the conductivity
2. Test if they can be isolated



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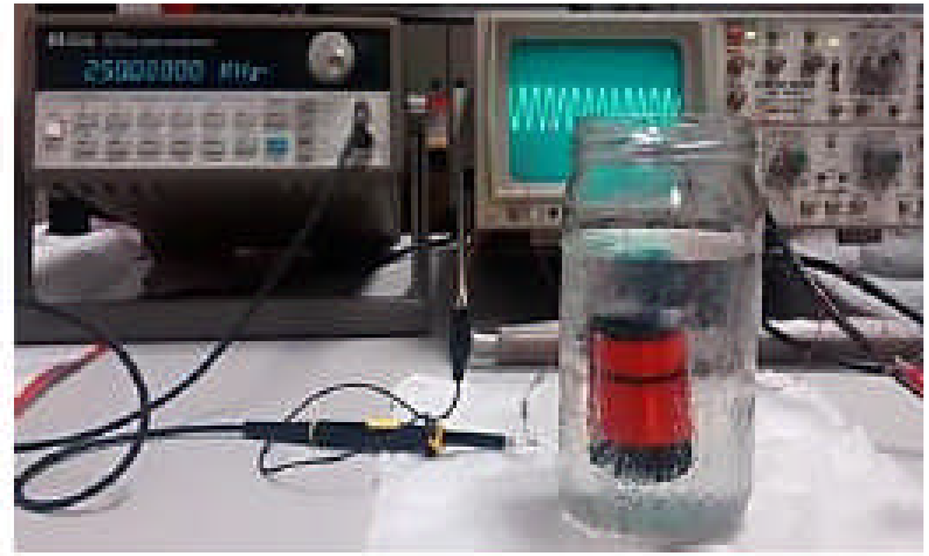

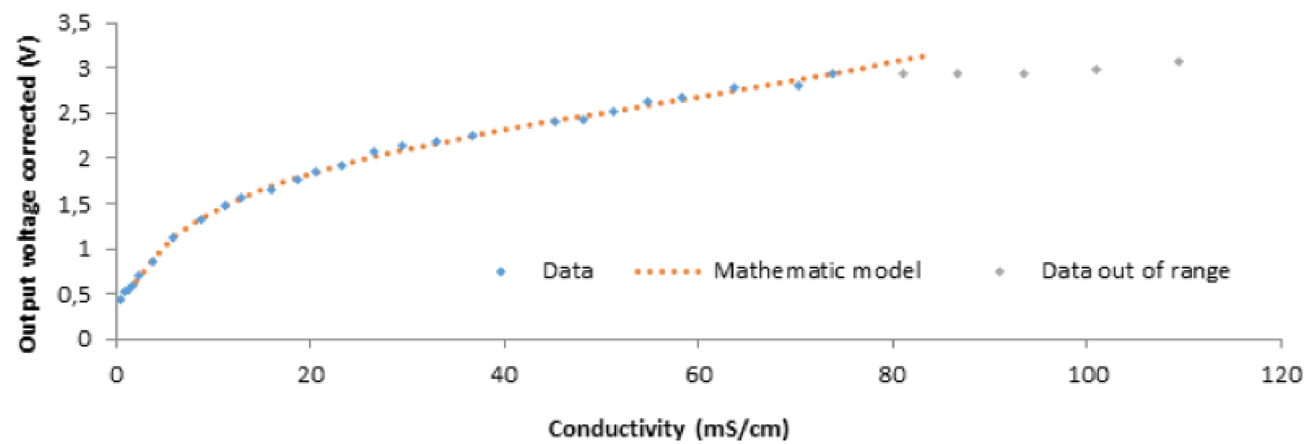

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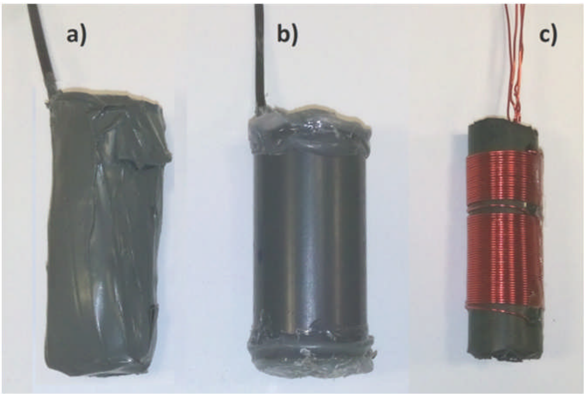
Copper coils can be used and can be isolate →



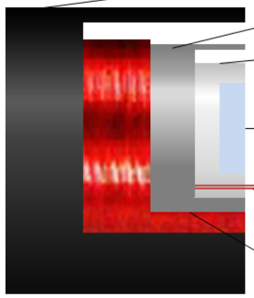
a) Isolated with waterproof paint

b) Isolated with PVC covers

c) Non-isolated

Prototype a) does not work
Prototype b):

$$Cond.\left(\frac{mS}{cm}\right) = \sqrt[0.4004]{22.7108 - \frac{24.375}{0.524 \times V_{out}\ (V) + 1.867}}$$



Parra, L., Sendra, S., Lloret, J., & Rodrigues, J. J. (2017). Design and deployment of a smart system for data gathering in aquaculture tanks using wireless sensor networks. International Journal of Communication Systems, 30(16), e3335.

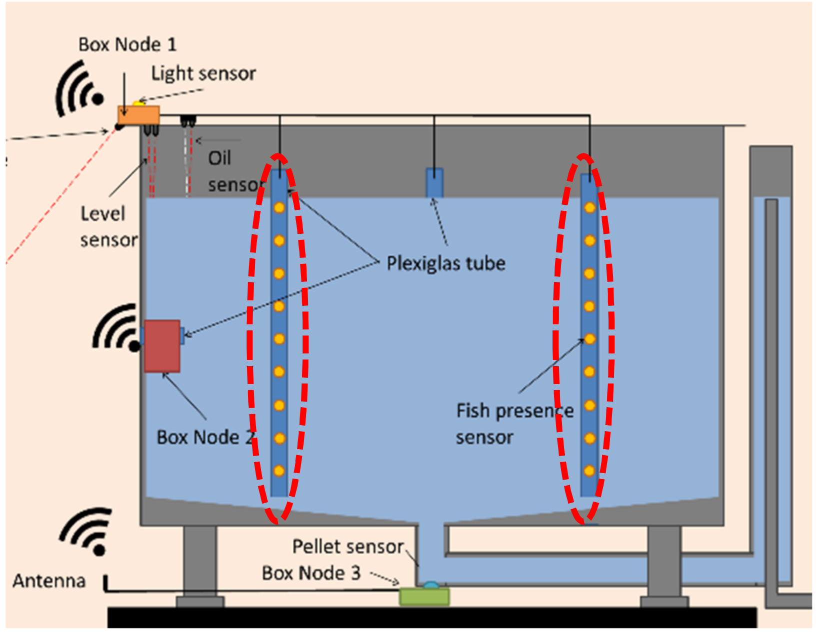
Fish presence sensors

Motivation: Detect the presence of fish in a tank

Task: Measure the location of fish and estimate their velocity with LDRs

Objectives:

1. Evaluate if LDRs can be used to detect the presence of a single fish.
2. Estimate the velocity of a group of fishes



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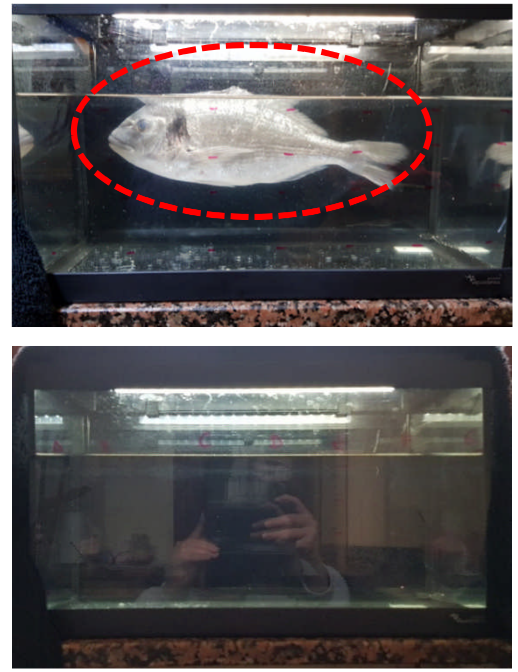

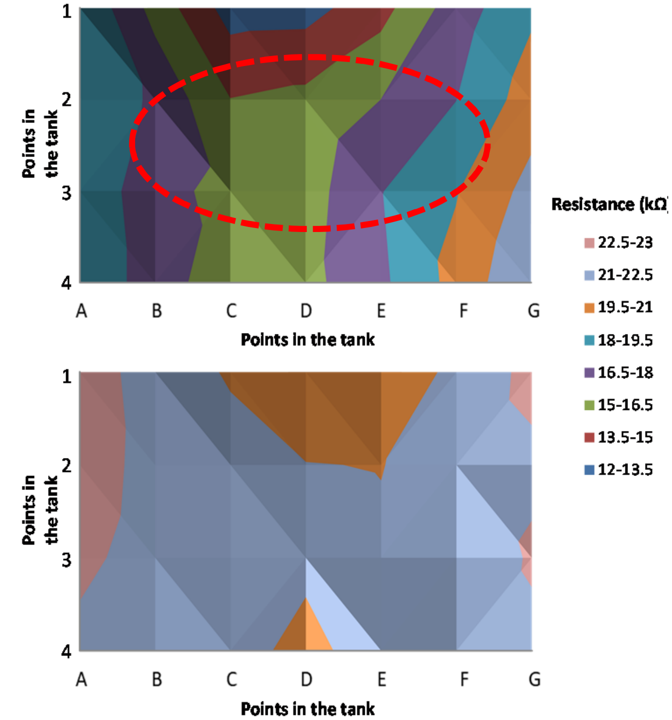

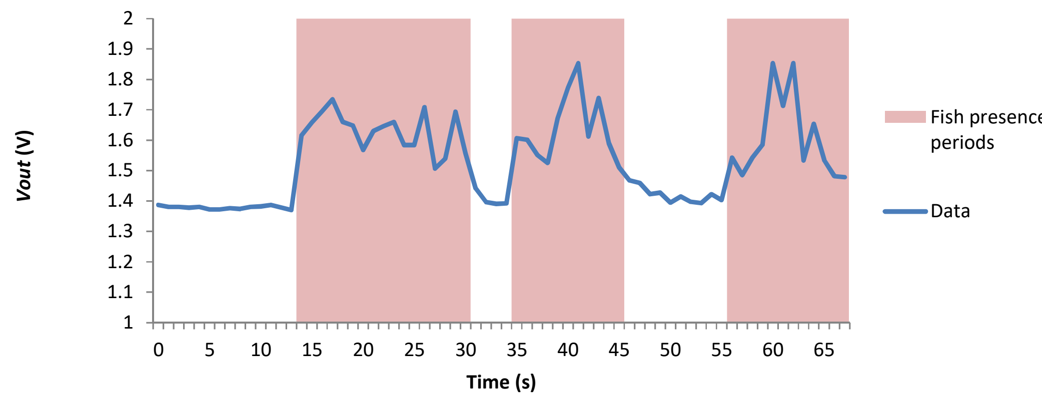

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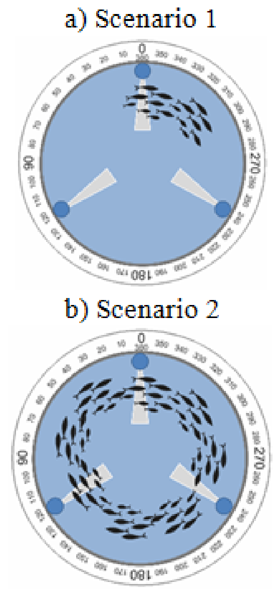
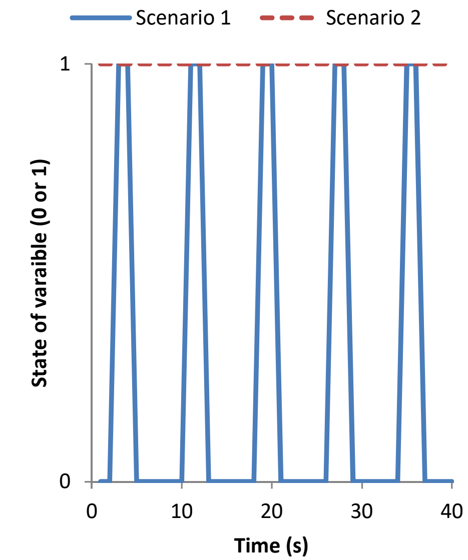
It is possible to measure the velocity in Scenario 1 and estimate its variation it in scenario 2 →



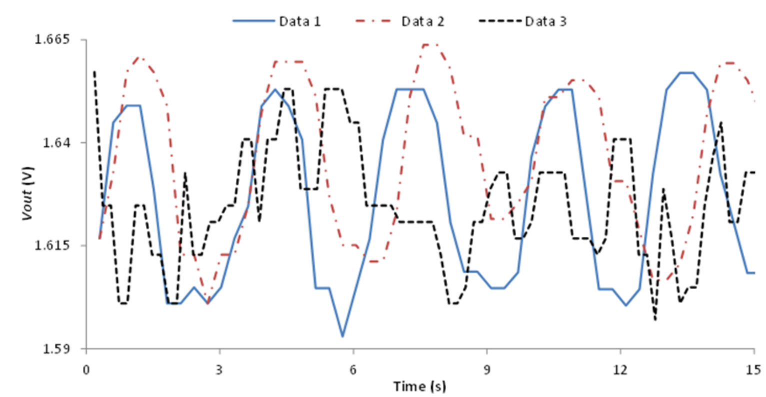

```
void loop()
{
 if (x < (totalRun*60*1000/delayTime))
  {
  x=x+1;
 valuePre = analogRead(sensorPinPre);
  voltPre = valuePre* 3.3/1024.0;
if (voltPre >= 1.5) {
    presence = 1;
  }else
  {
  presence = 0;
  }

}
```



Scenario 1: $MV\ (\frac{m}{s}) = \frac{(\emptyset Tank\ (m) \times 0.9) \times \pi}{Time\ between\ intervals\ (s)}$

Scenario 2: $IMV = \frac{nº\ of\ peaks}{time\ (s)}$



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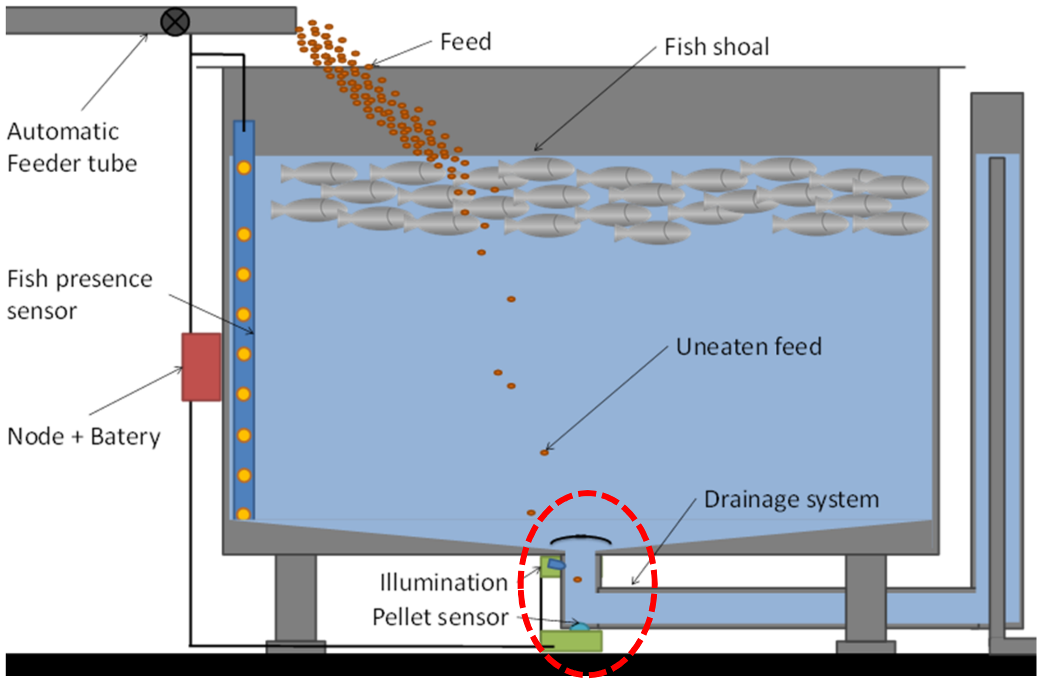
Feed detection sensors

Motivation: Detect the falling of uneaten feed

Task: Use image processing to detect feed

Objectives:

1. Evaluate the use of images with low resolution to identify the feed falling



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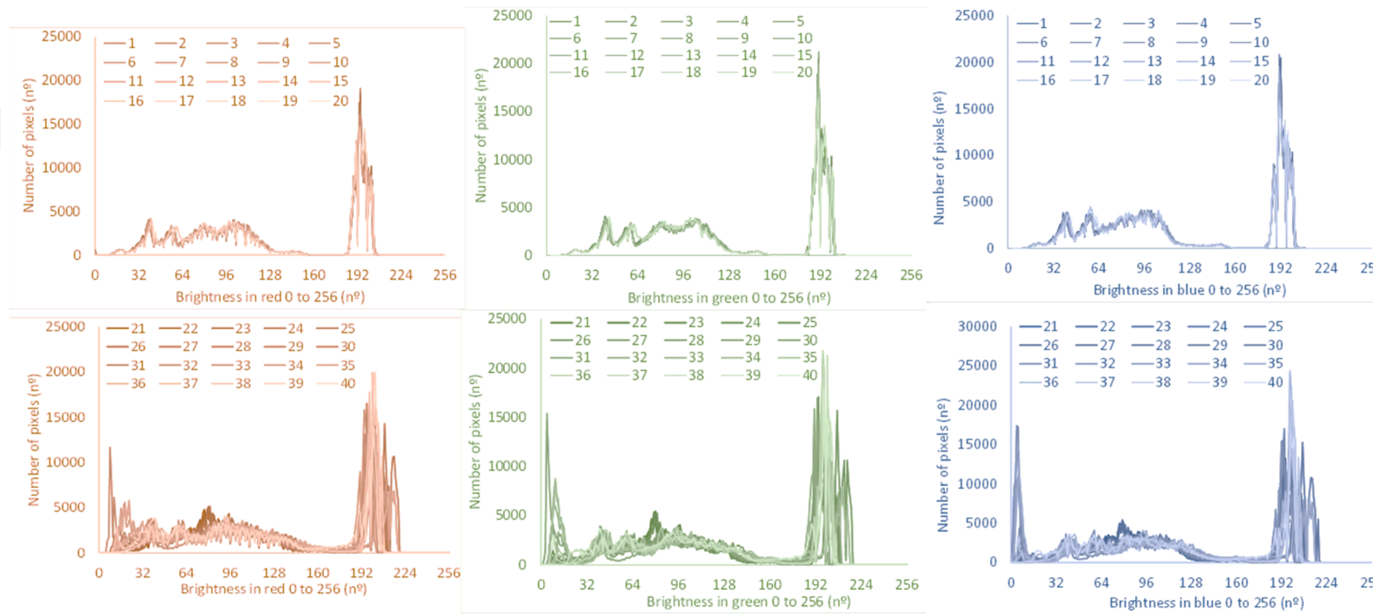
RGB Histograms of images without feed falling



RGB Histograms of images with feed falling

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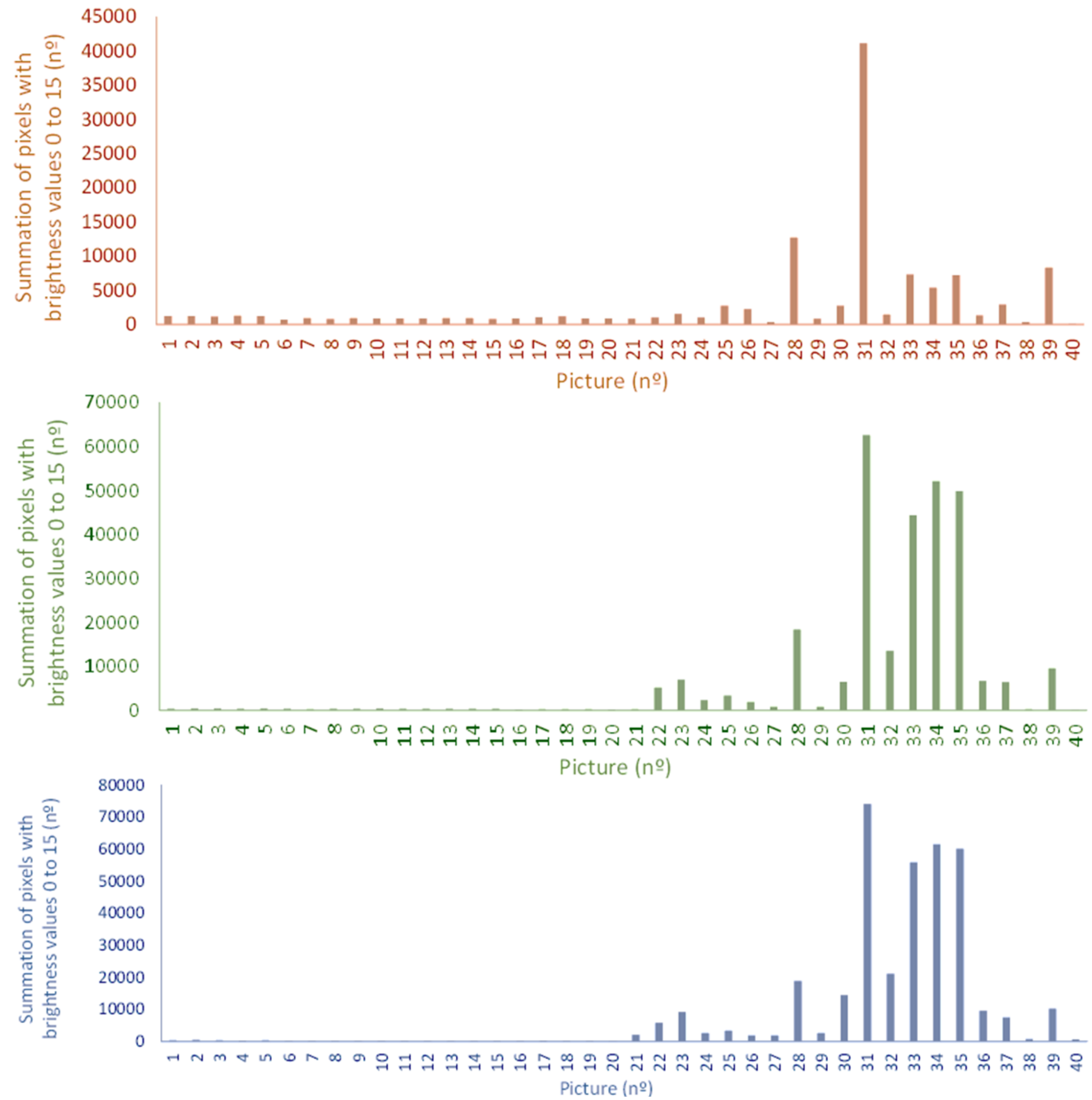
∑pixels 0-15 → 1-20 Without feed, 21-40 With feed



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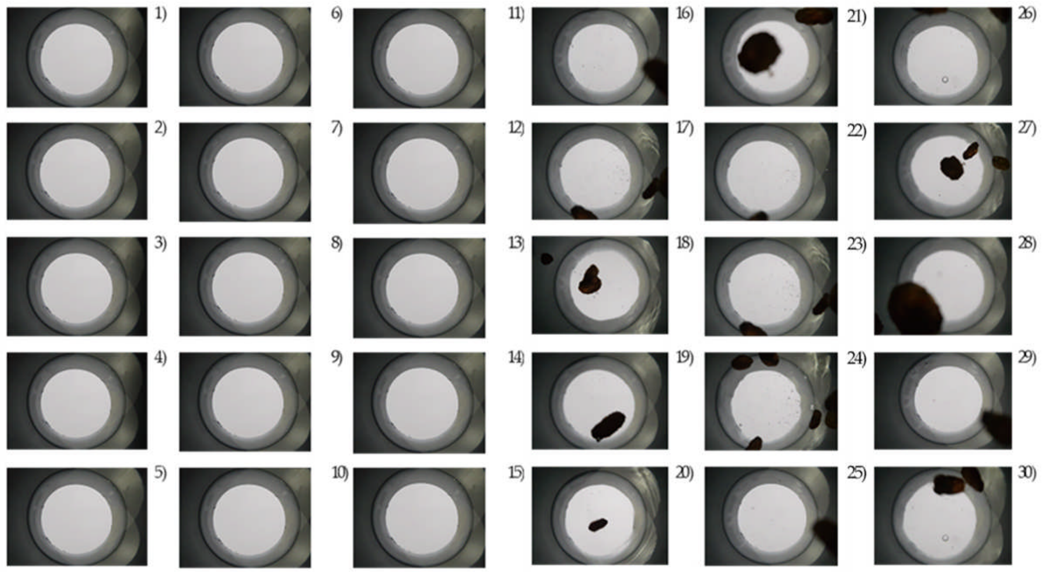
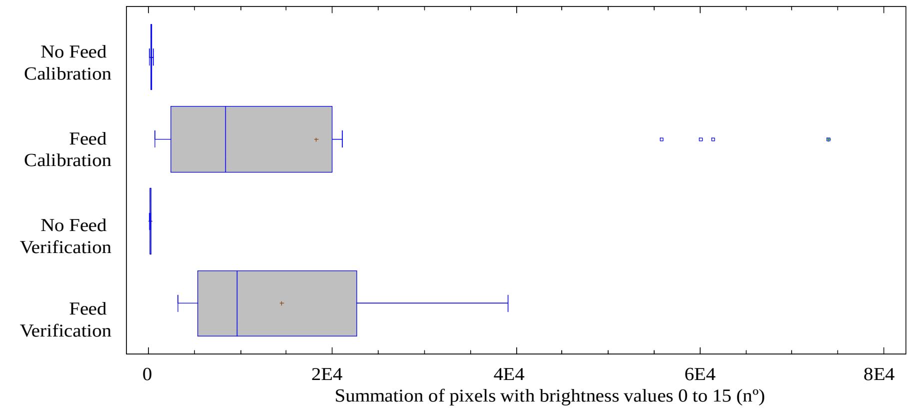
Histograms can be used to identify feed faaling →

Verification:





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Panellist Position

Self-Power Monitoring Systems

Mojtaba Ghodsi, University of Portsmouth, Portsmouth/UK Mojtaba.Ghodsi@port.ac.uk

- ❖ Smart materials and structures
- ❖ Sensors (GMM and PZT)
- ❖ Energy harvesters for IoT applications

✓ No need to use battery to energize the monitoring sensors

Panellist Position

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Introduction

There are some structures that are existing or operating in harsh environments or remote areas.

↓

Their health need to be monitored

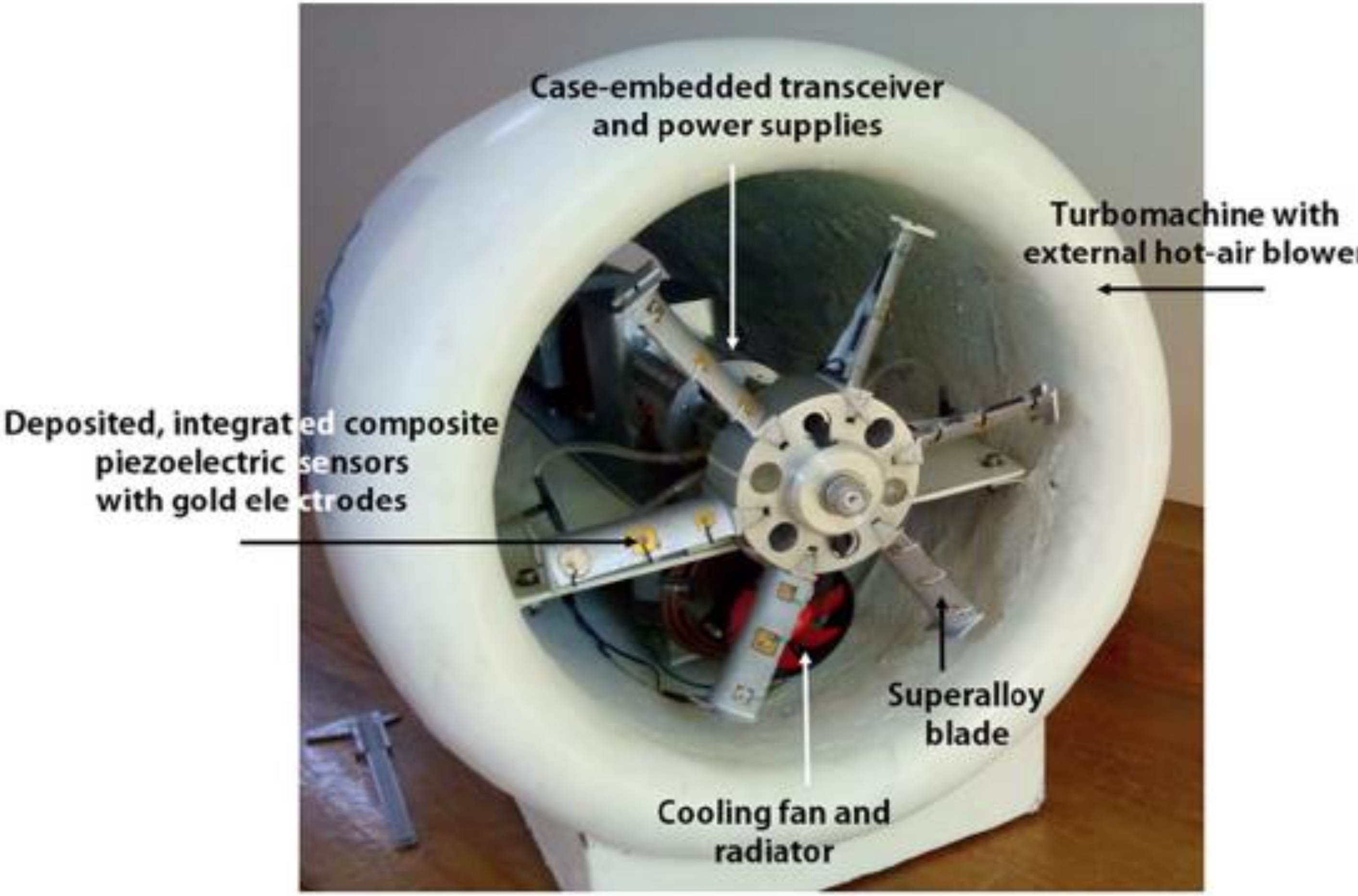
↓

Development of **Sensors** to operate in harsh environment/remote area are essential

↓

Self-Power Monitoring Systems

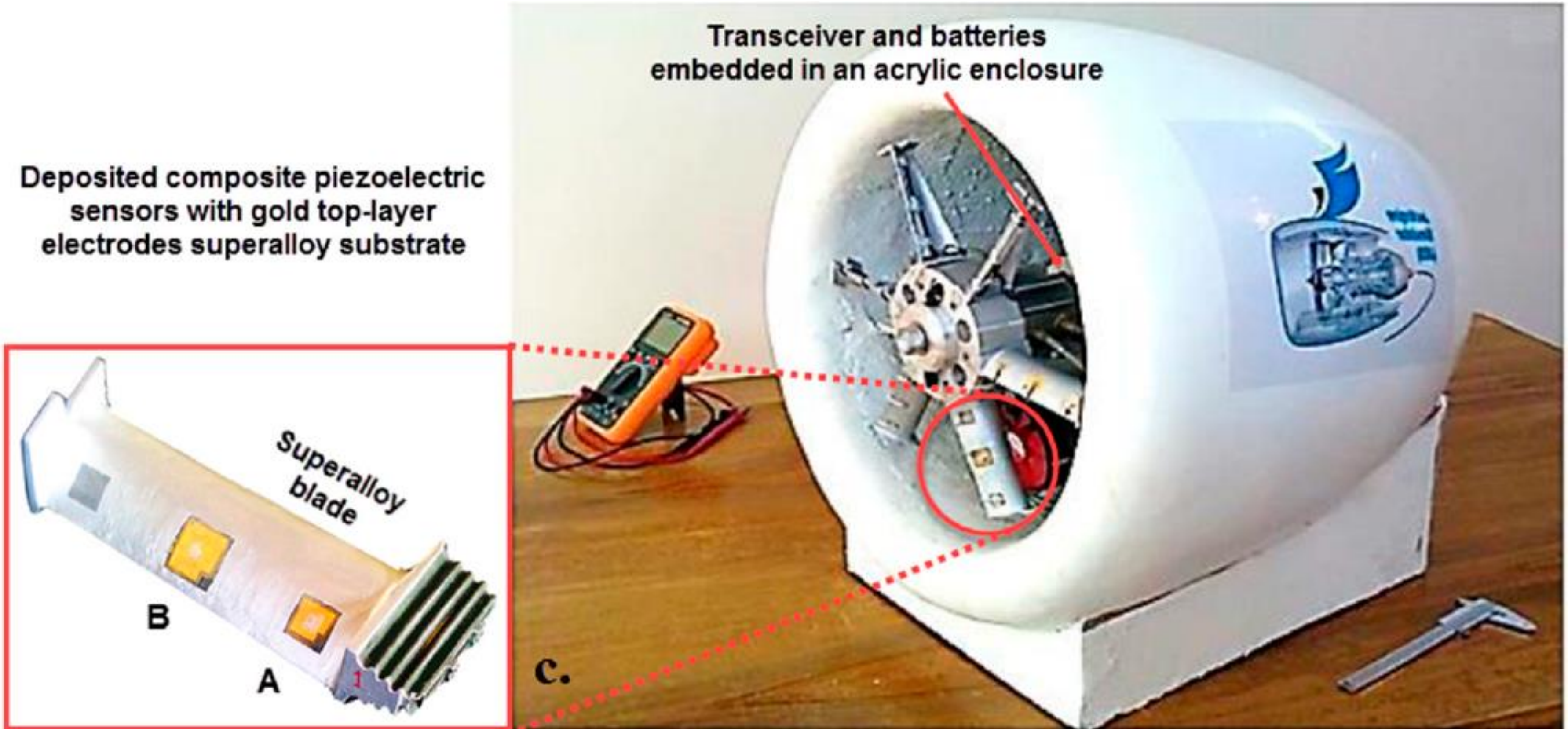
Monitoring System for Harsh Environments



[Hoshyarmanesh, Ghodsi, Sensors, 2019]

Health monitoring of Blade in an aerospace structure at 200 °C

Monitoring System for Harsh Environments



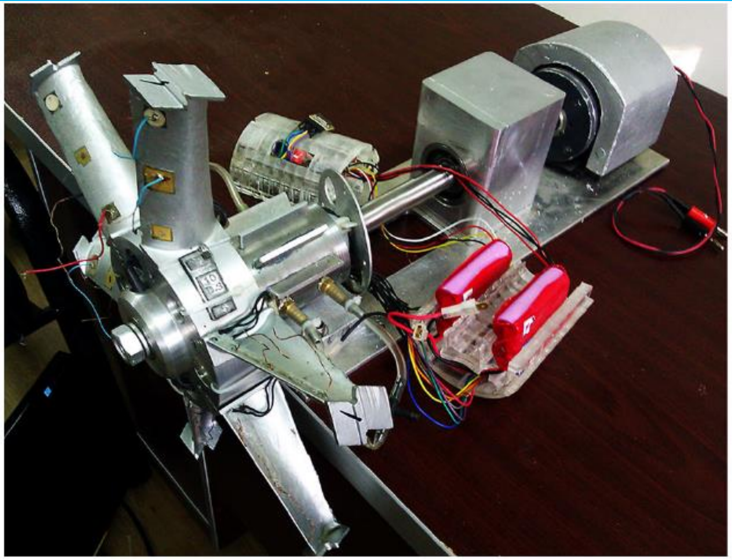
[Hoshyarmanesh, Ghodsi, Sensors, 2019]

Piezoelectric Active Wafer Sensors, 200 °C

Power supply is essential to energize the transducers

Challenges of Monitoring Systems

[https:encyrypted-tbn1.gstatic.com]



[Hoshyarmanesh, Ghodsi, Sensors, 2019]

Health monitoring systems need power to operate

Battery disadvantages

- Periodic replacement
- Poor operation in harsh Con.
- Pollution in environment
- Inaccessible region (forest, off shore)

→

Energy-Harvester

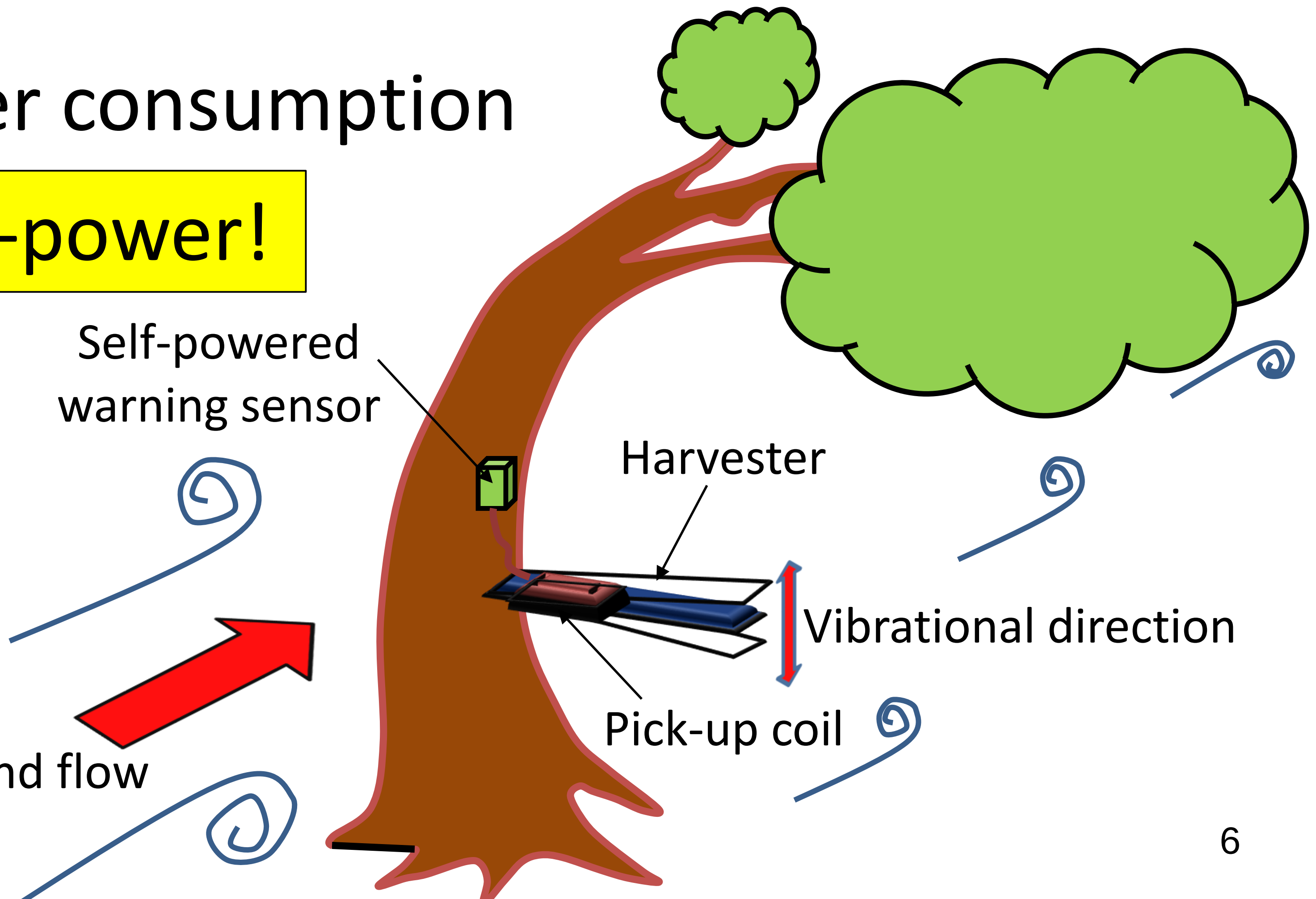
- Maintenance-free
- Self-powered
- Eco-friendly

Self-Power Monitoring System?

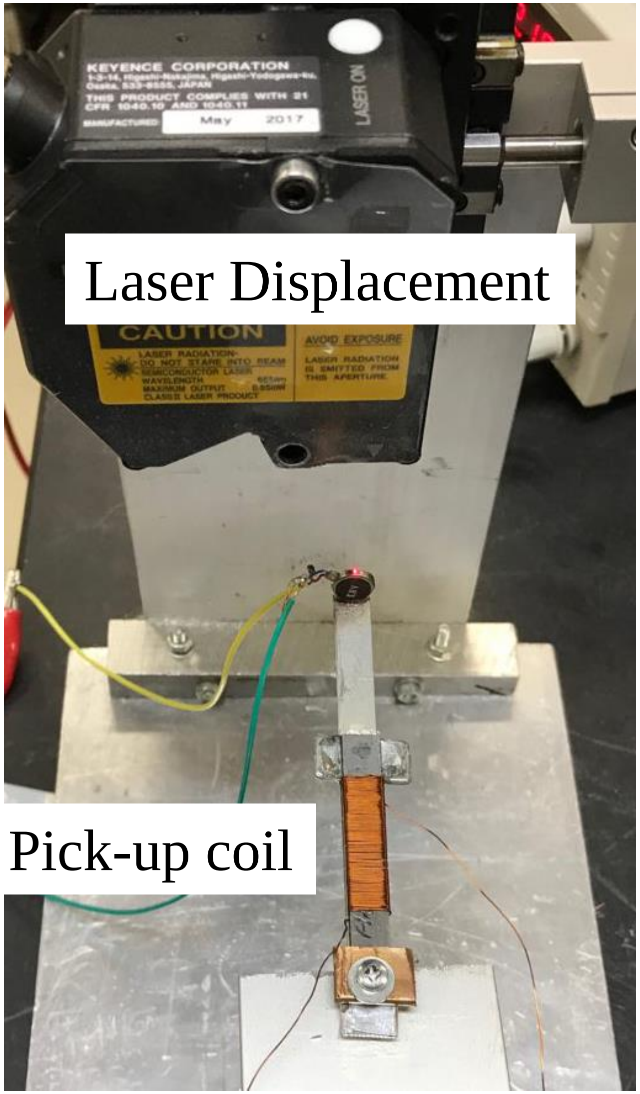
Using Smart Materials for monitoring

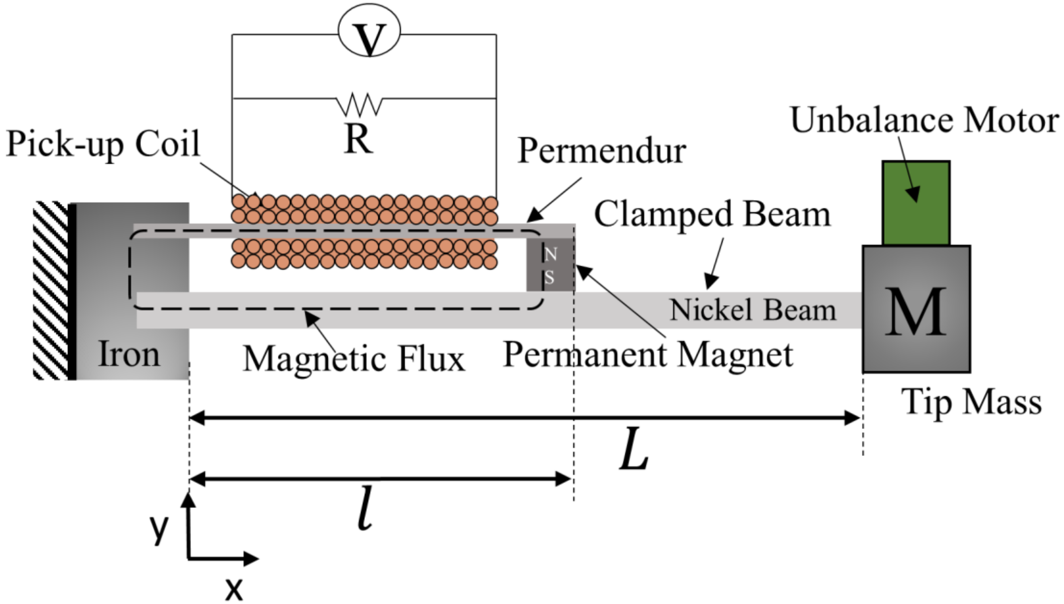
Less power consumption

Zero-power!



Development of Vibration-Based Energy Harvesters

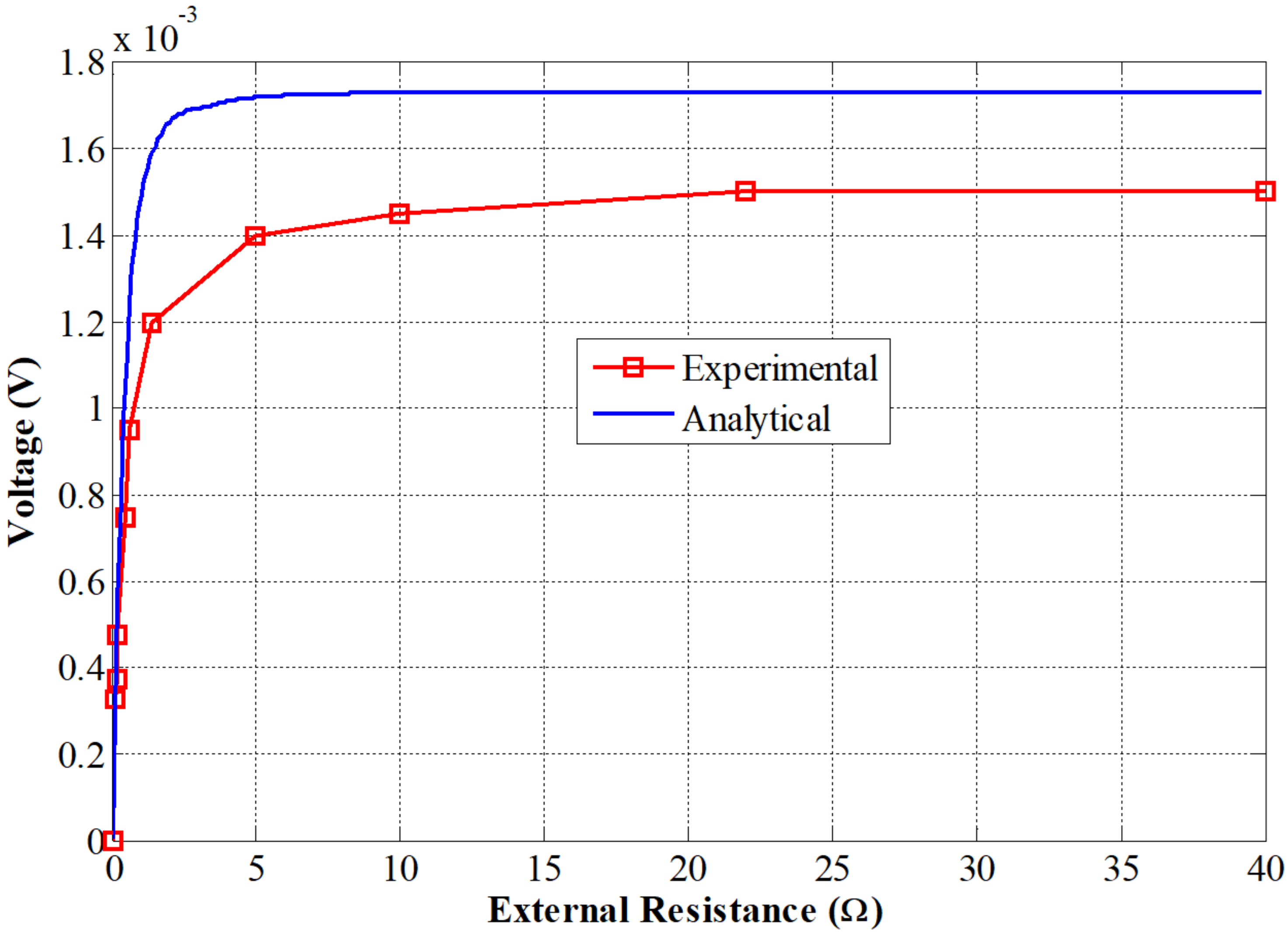




Velocity-driven harvester

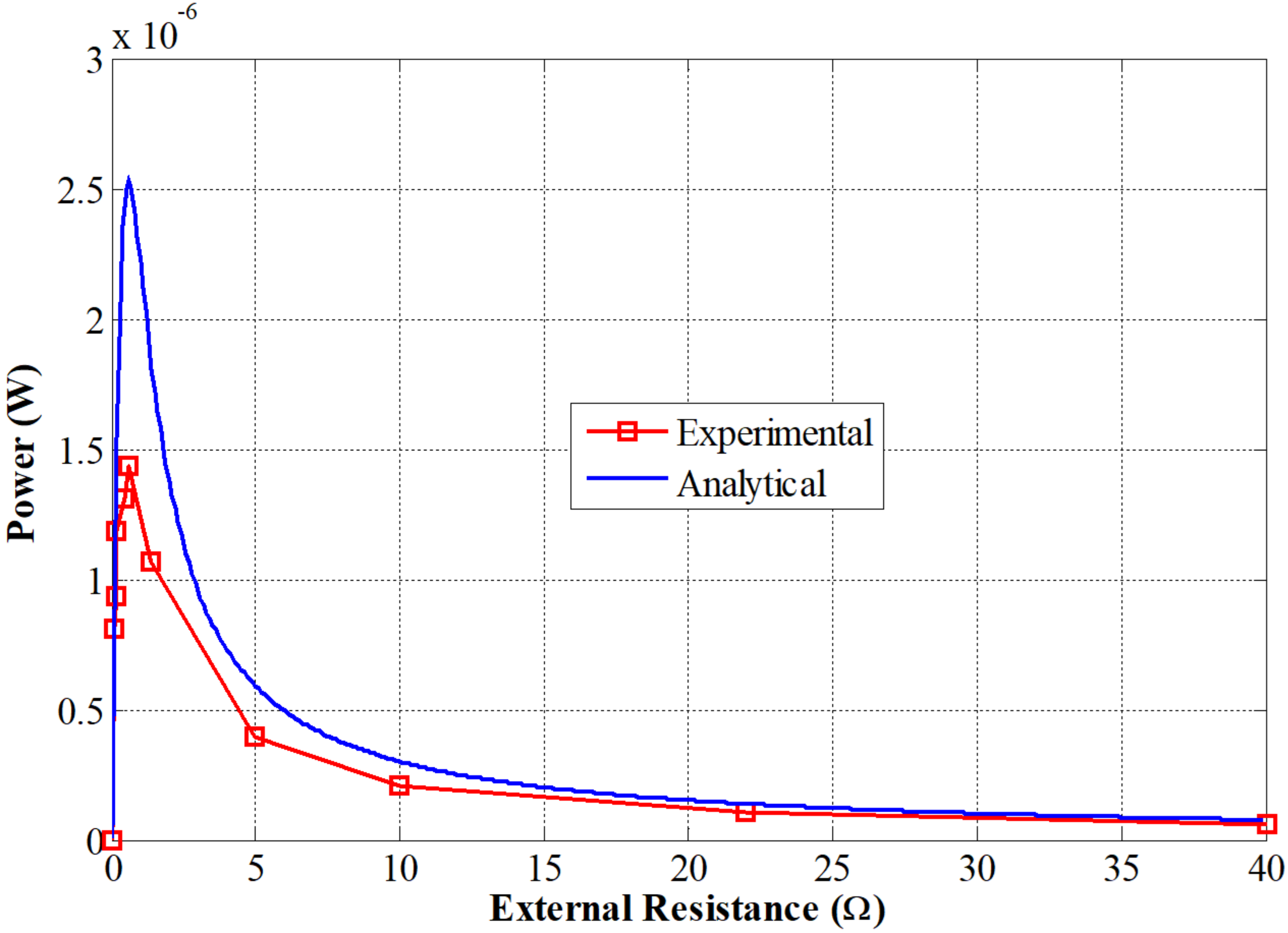
[Ghodsi, Energy, 2019]

Results



mV harvested voltage

Results



Micro-Watt power extraction

Conclusions

1. A vibration-based energy harvester to energize monitoring system is developed.

2. Measured the harvester’s voltage and power
    - ❖ Harvested voltage is1400µV
    - ❖ Harvested power density 2.72 W/m^3

3. Developed harvester is suitable for new generation of MEMS sensors, low-power VLSI, biomedical implants and CMOS and all micro-power consumption devices.

Panelist Position

Crowdsensing in public health

Niels F. Garmann-Johnsen, Assoc. prof. UiA, Norway niels.f.garmann-Johnsen@uia.no

- Participatory crowdsensing
- Opportunisitic crowdsensing
- Advantage of ubiquitous presence of powerful mobile computing devices
- Process
- Challenges

→ Benefits and opportunities

UiA University of Agder Norway

The Core of Design Thinking, and its Impact on Digital Transformation in Healthcare

eTELEMED 2020

Niels F. Garmann-Johnsen
Dept. of Information Systems,
UiA, Kristiansand, Norway
e-mail: niels.f.garmann-johnsen@uia.no

Migle Helmersen
UiA, and Dept. of Societal research,
NORCE research inst., Kristiansand, Norway
e-mail: migle.helmersen@uia.no

Tom R. Eikebrokk
Dept. of information systems,
UiA, Kristiansand, Norway
e-mail: tom.eikebrokk@uia.no

UiA

Agenda

Motivation and research problem

Method

Findings

Summary

UiA

Motivation and research problem

- This study contributes to creating awareness about the potential of Design Thinking in healthcare
- Although popular in practice, there has been a gap in academic literature, especially in Information systems, regarding the impact of Design Thinking in this context
- Dorst's article «The core of 'design thinking' and its application» lays out the theoretical foundation for Design Thinking. This fundament builds on abduction as the third inference method of social science research (the first two being Induction and deduction, respectively)
- The term 'Abduction' stems from Charles Sanders Peirce (1839–1914), the founder of American Pragmatism philosophy, and describes an approach to science which commences with one or more observations and then seeks the simplest and most likely explanation to observed phenomena

Method

- Review of the literature showed that this innovation-philosophy and paradigm has had a high impact on several sectors, especially the Information Technology sector
- Something that in its turn, impacts healthcare
- Doing a literature review based on a central source of design thinking paradigm, Kees Dorst, the authors explore examples of such impact and generalize a picture of the state of art in this field

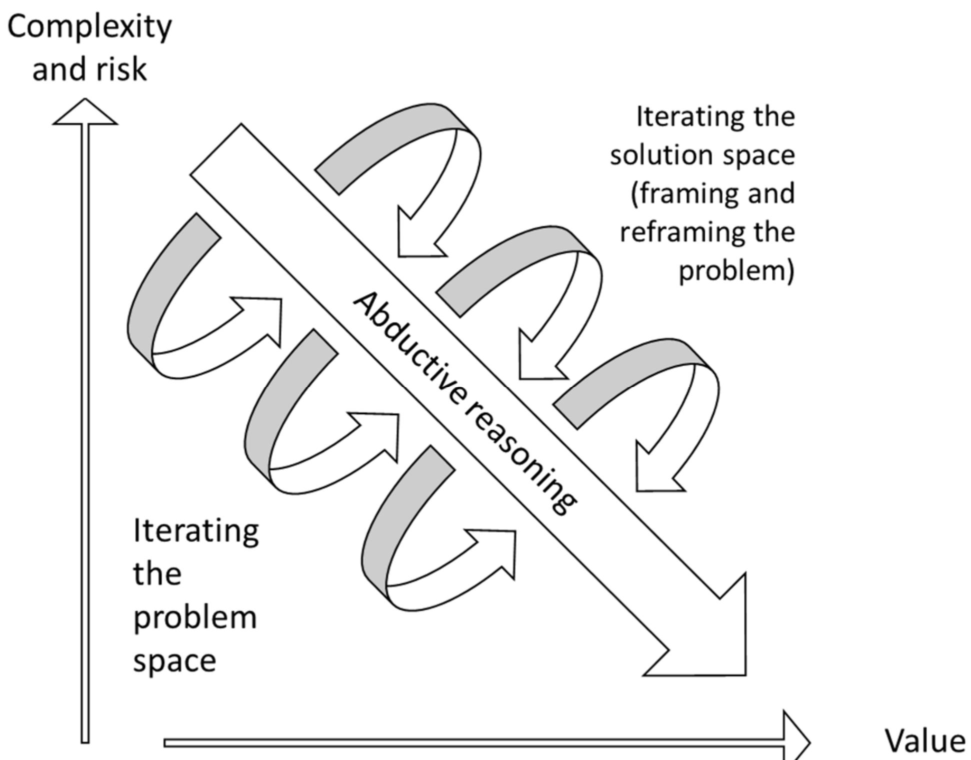
Findings

- Definitions of Design Thinking in healthcare, and Design Thinking methods applied
- How Design Thinking designer practices are dealing with complexity in healthcare
- Some potential pitfalls in applying Design Thinking in healthcare, and what kinds of caution should be applied
- The potential positive outcome of applying Design Thinking methods, for the care providing organizations and for care-receivers

(Examples, and references in article)

Summary

- The Design Thinking practices for dealing with complexity, "wicked problems", like often found in healthcare innovation dilemmas, makes the methodology appropriate in this context
- Design Thinking methods for dealing with complexity involves abductive reasoning, framing and reframing of the problem, as illustrated in Figure (right)
- Design Thinking in healthcare does not annihilate the needs for normal change management procedures, like getting all employees on board as involved and engaged, and employing proper governance methods.



Panelist Position

Much Like the Industrial Revolution, Digitalization is Proceeding to Change Learning models, Teaching models, Workforce models and Business models; Transforming Society without Control

Roger Tilley, Sandia National Laboratories, California, USA rtvax@sandia.gov

- 1st Industrial Revolution – late 18th Century to early 19th Century – steam power, less labor, less time to produce items, urban growth
- 2nd Industrial Revolution – late 19th Century to early 20th Century – steel, electric, automobile, less labor, less time, urban growth
- Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – big data analytics, production and workforce consolidation

→ Substituting labor processes - automation

→ Machine-supported decision making

→ Accumulation of knowledge into algorithms reducing need for experts

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Panel 1

Theme: Digital Processing and Services

Topic: Sensing and Digitalization in Societal Transformation

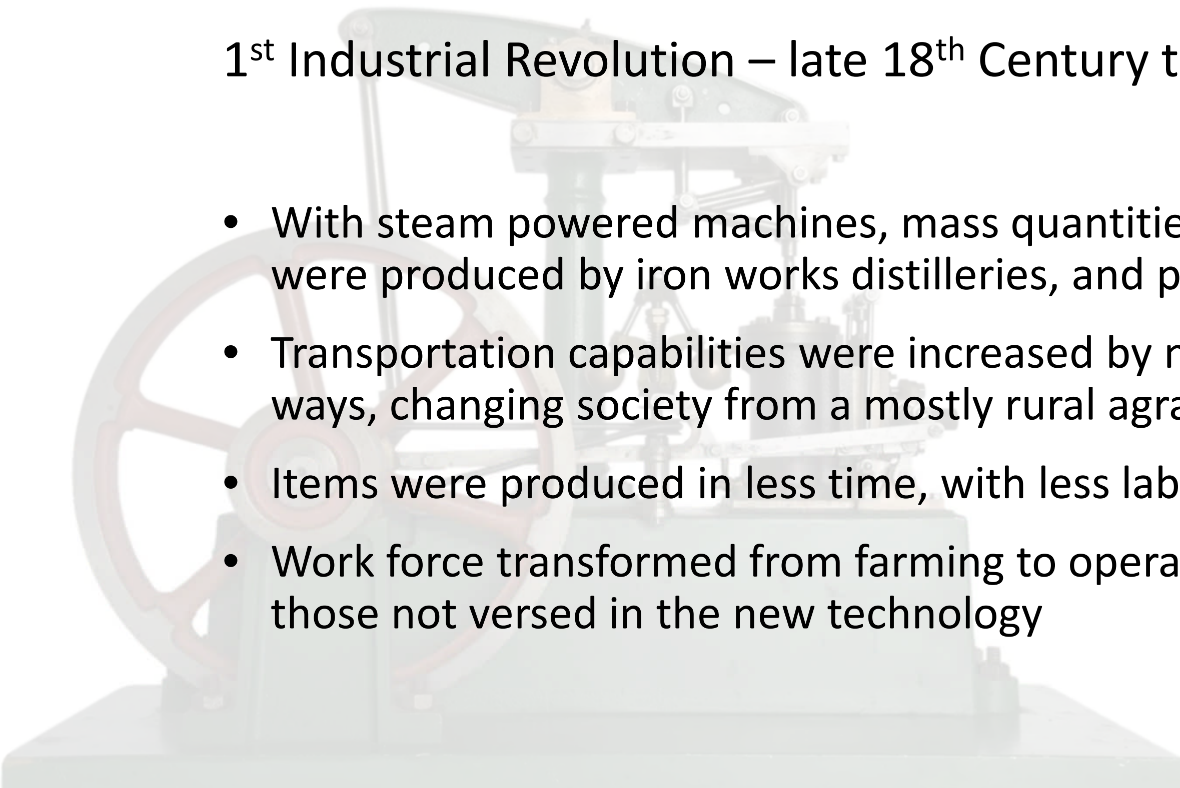
(crowd sensing, agricultural sensing, livestock, traffic sensing, pollution sensing, spatial sensing, vital signs, sensitivity, and accuracy, etc.)

Digital World 2020

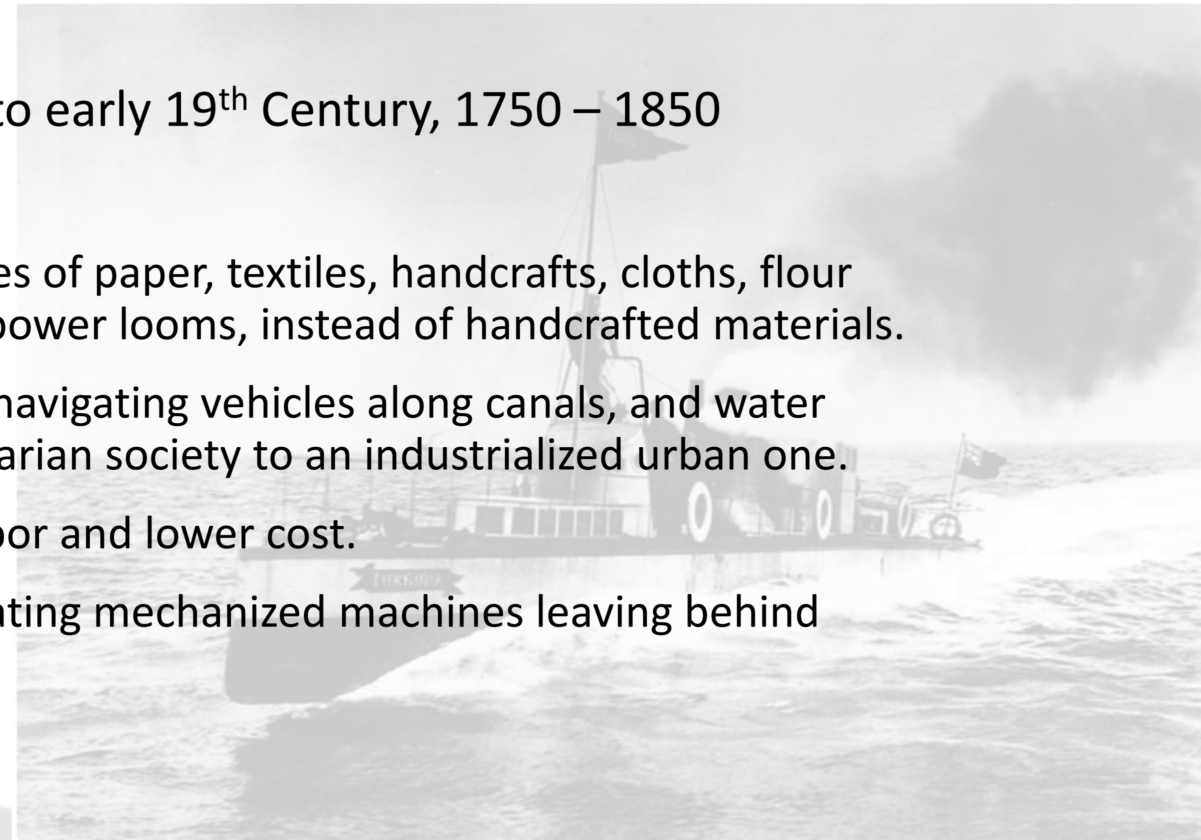
Panellist Position

1st Industrial Revolution – late 18th Century to early 19th Century, 1750 – 1850

- With steam powered machines, mass quantities of paper, textiles, handcrafts, cloths, flour were produced by iron works distilleries, and power looms, instead of handcrafted materials.
- Transportation capabilities were increased by navigating vehicles along canals, and water ways, changing society from a mostly rural agrarian society to an industrialized urban one.
- Items were produced in less time, with less labor and lower cost.
- Work force transformed from farming to operating mechanized machines leaving behind those not versed in the new technology

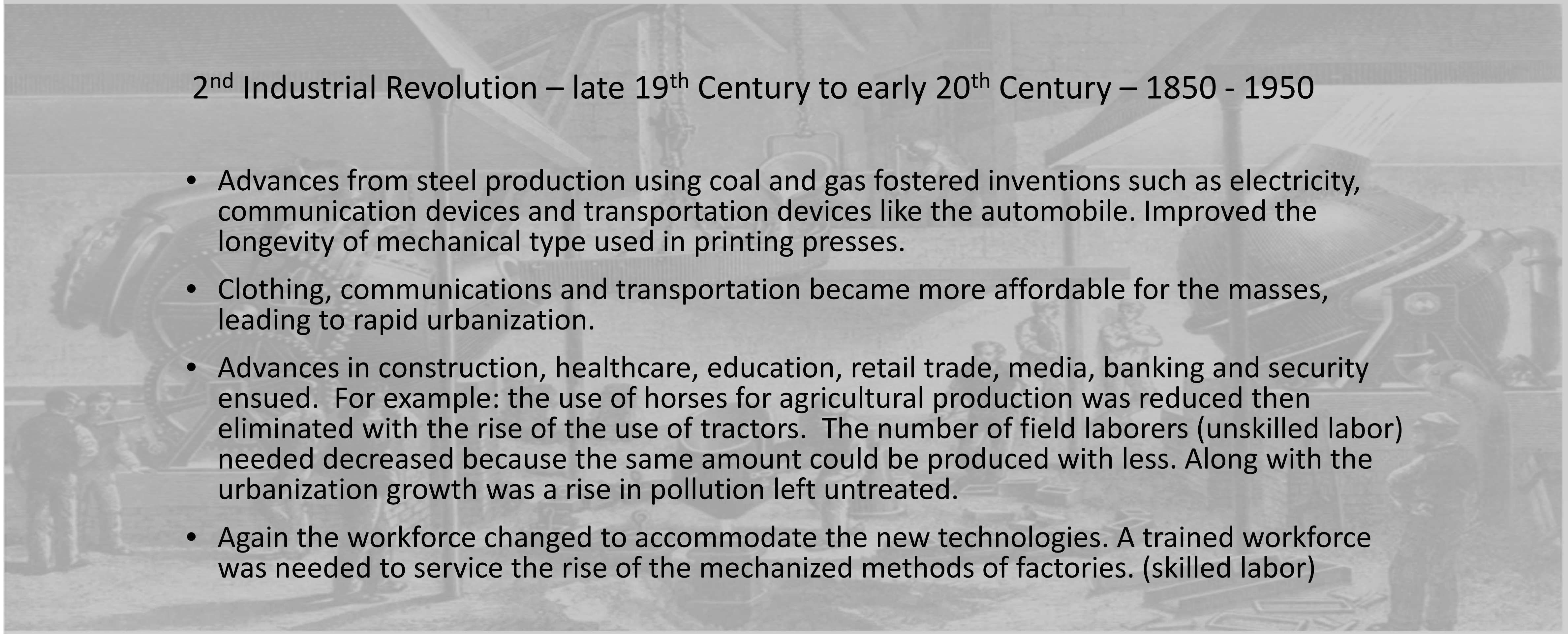


The steam engine facilitated major advancements in the fields of mining, manufacturing, agriculture and transportation.
(Image: © Baptist | Shutterstock)



Charles Parsons' Turbinia yacht, seen here in 1897, was the first steam turbine-powered ship. Photo: Alfred John West (1857-1937)

Panellist Position

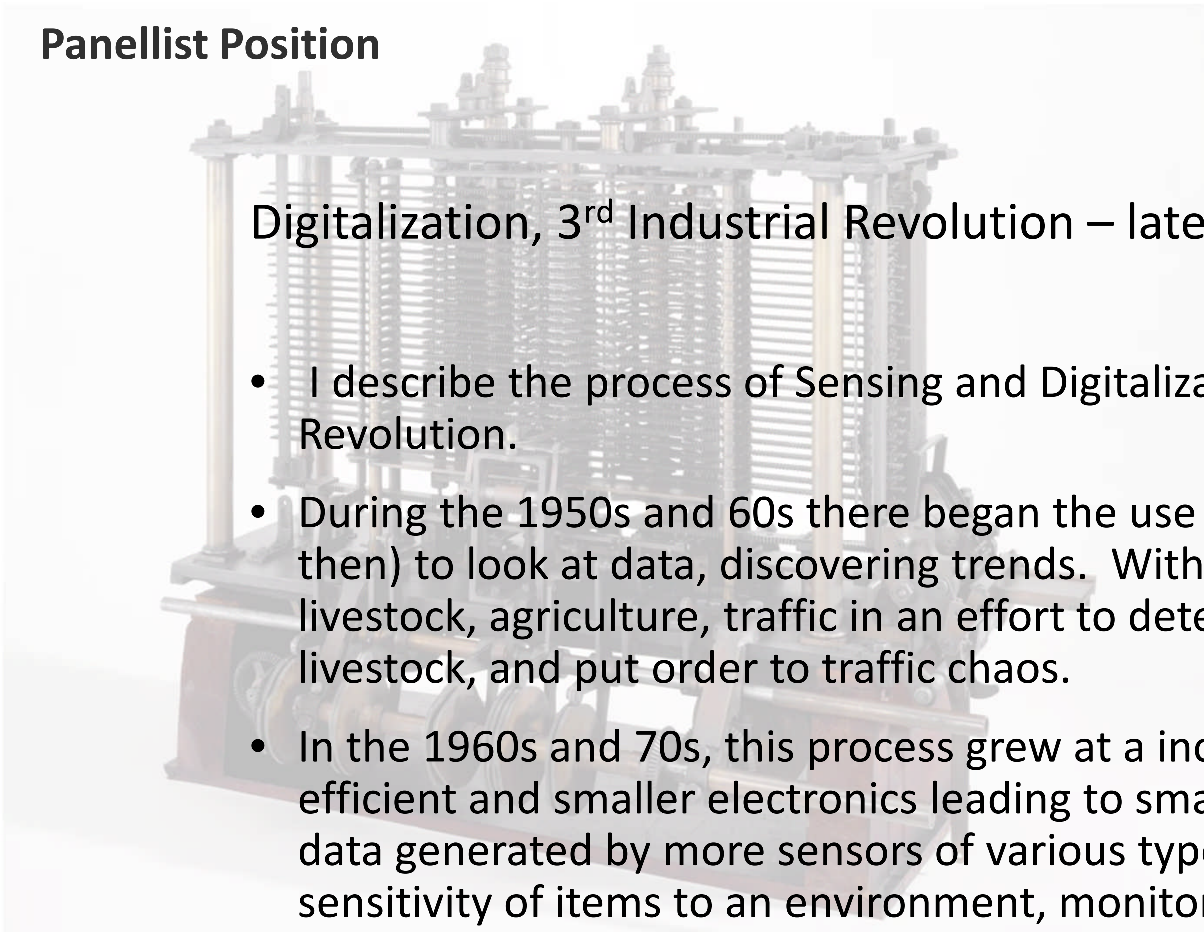


2nd Industrial Revolution – late 19th Century to early 20th Century – 1850 - 1950

- Advances from steel production using coal and gas fostered inventions such as electricity, communication devices and transportation devices like the automobile. Improved the longevity of mechanical type used in printing presses.
- Clothing, communications and transportation became more affordable for the masses, leading to rapid urbanization.
- Advances in construction, healthcare, education, retail trade, media, banking and security ensued. For example: the use of horses for agricultural production was reduced then eliminated with the rise of the use of tractors. The number of field laborers (unskilled labor) needed decreased because the same amount could be produced with less. Along with the urbanization growth was a rise in pollution left untreated.
- Again the workforce changed to accommodate the new technologies. A trained workforce was needed to service the rise of the mechanized methods of factories. (skilled labor)

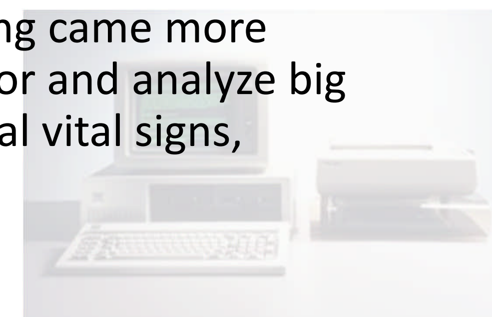
Universal History Archive/Getty Images

Panellist Position



Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – 1950 - 2050

- I describe the process of Sensing and Digitalization in Societal Transformation as the 3rd Industrial Revolution.
- During the 1950s and 60s there began the use of computers (very large and cumbersome machines then) to look at data, discovering trends. With that the development of sensors to monitor livestock, agriculture, traffic in an effort to determine the best time to harvest crops, breed livestock, and put order to traffic chaos.
- In the 1960s and 70s, this process grew at a increased rate. With better data mining came more efficient and smaller electronics leading to smaller and faster computers to monitor and analyze big data generated by more sensors of various types to determine crowd sizes, medical vital signs, sensitivity of items to an environment, monitor pollution, etc.



Famed mathematician Charles Babbage designed a Victorian-era computer called the Analytical Engine.
This is a portion of the mill with a printing mechanism.
(Image: © Science Museum | Science & Society Picture Library)

Panellist Position

Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – 1950 - 2050, Continued -

- During the 70s, 80s and 90s the rate of change seemed exponential. Fewer big factories. Item costs dropping, allowing more to purchase goods that were out of reach earlier. Workers flocking to the cities, abandoning tradition agricultural work. A more skilled work force developed.
- Data driven managerial decision making grew. New opportunities on individual, organizational and societal levels were fostered. Machine based interpretation of data arose rather than a few experts
- Centralized production became favored, consolidating markets. Tastes, habits, expectations become so similar around the world that production of fewer types of items delivered globally reduced distribution costs, less capital assets, less employment and more inequality between large and small businesses.

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Panel 1

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Digital World 2020

Panellist Position

Digitalization, 3^{rd} Industrial Revolution – late 20^{th} Century to early 21^{st} Century – 1950 - 2050, Continued -

- This trend continued during the 90s and 2000s and beyond, professional production is replaced by cheaper more plentiful copies based on digital innovations. Fewer professional jobs are available because the new digital products and services replaced their physical and analog counterparts. Bloggers replace journalist and magazines are replaceable by tablets.
- Through digitalization and big data analytics, traditional hierarchical work structures dissolve transforming into flexible in-house networked structures spatially distributed across non specific locations, flexibly timed. This lead to the integration of external freelancers and the development of cooperation between enterprises like crowd sourcing of ideas and processing of financial funds.
- Transaction costs for collecting information, communication and control of activities experienced a steady reduction.

IBM Mark-I

Panellist Position

Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – 1950 - 2050, Continued -

- Well established firms tend not to adjust rapidly enough and struggle to survive. Start-ups exploit distribution channels and establish new forms of customer engagement and relationships. Labor is substituted for machines. Robots, information kiosks, elemental knowledge based cognitive work processes contained in algorithms accumulate the knowledge replacing high-level decision makers with machine supported decision making.
- Knowledge based business models and cognitive workers (skilled) will be affected harder and faster than non-knowledge based business models and manual workers. Modern production becomes impossible without analysis of data, networked systems, artificial intelligence and digitalization of business processes.

Panellist Position

Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – 1950 - 2050, Continued -

- The effects on society is not clearly detrimental in all cases but there is a list where it is questionable.
- Education is changed: teachers take on the role of mentors, classrooms move to on-line courses, learning becomes more accessible; content is tailored to an individual more speedily; free content based video courses.
- Labor: Retraining to reduce gaps between the need and the supply of qualified labor in a new area; Adults will change jobs several times.
- Digital inequality arises for those who are unable or unwilling, for the elderly, and people with lower levels of education to make use of the digital opportunities; creating risks of societal exclusion and inequality.
- The hopes that access to technology would lead to an equal distribution of wealth have not occurred as yet.

Panellist Position

Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – 1950 - 2050, Continued -

- Information processing tasks performed by firms and skilled knowledge workers generate high profits and wages, providing economic incentives to speed up substitution of digital advances. With digitalization and big data analysis providing autonomous information processing, the substitution process moves even faster without control.
- There appears no method to control or slow down this process except a world-wide pandemic. In lieu of this, future research should focus on ways to cope with upcoming changes and challenges on how these information communication technology systems (digitalization and big data analytics) can be built and used in sustainable and beneficial ways for humankind.

Panellist Position

Digitalization, 3rd Industrial Revolution – late 20th Century to early 21st Century – 1950 - 2050, Continued -

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