



ERAdiate

When Social Robots meet Self-Driving Cars

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WORKSHOP "ROBOTICA E INDUSTRIA 4.0. PROSPETTIVE E PROBLEMI TRA INFORMATICA E DIRITTO

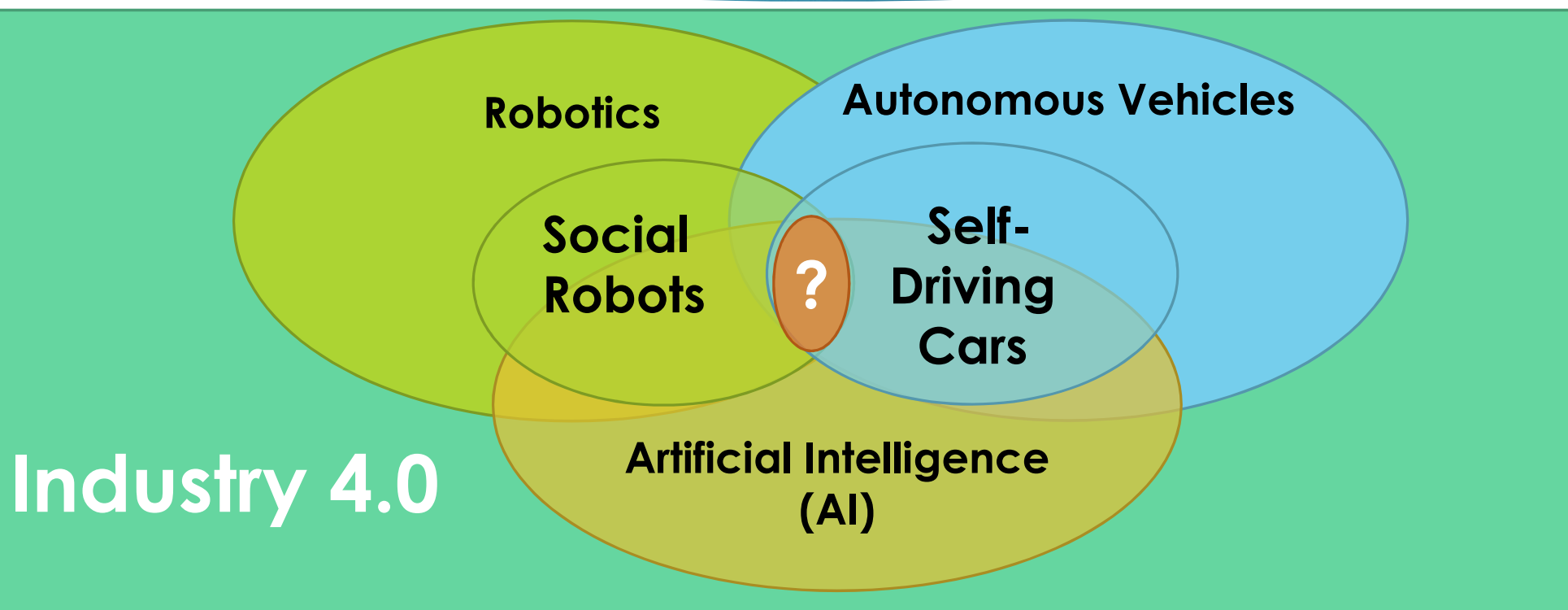
PORDENONE, 3 APRILE 2017

About the ERAdiate project

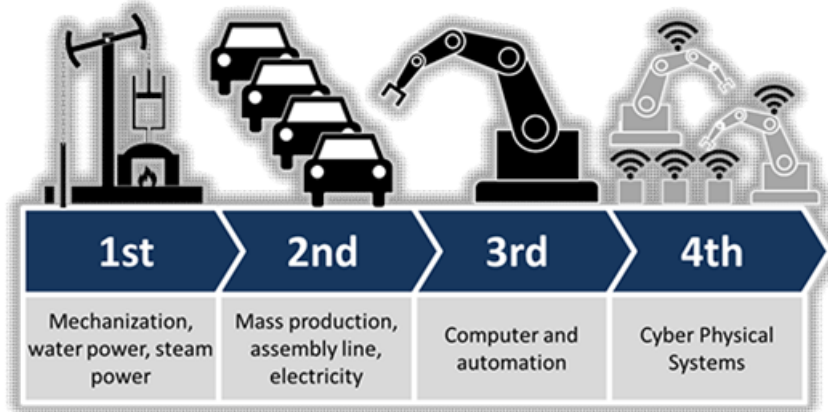
(University of Žilina, Slovakia)

- ▶ **ERA Chair project funded under FP7 Pilot (2014-2019)**
 - ▶ Contributes to H2020 pillar “Spreading Excellence and Widening Participation” expected to close the research and innovation gap in the EU
- ▶ **Realisation of full potential of the Univ. of Žilina and its region in the field of Intelligent Transport Systems (ITS)**
- ▶ **ERAdiate impacts beyond Research and Innovation**
 - ▶ Internationalisation,
 - ▶ Fostering Inter- Trans- disciplinarity
 - ▶ Institutional and structural changes
 - ▶ Regional impact by involving public and private actors in ITS initiatives and projects

Context



Industry 4.0



- ▶ Not only about “smarter factories”...
- ▶ Interconnection and interdependency of human beings, objects & systems
- ▶ Role of Humans and Autonomous Technologies in near-future society

Robots, a key driver of Industry4.0

(World Economic Forum 2016 Davos)

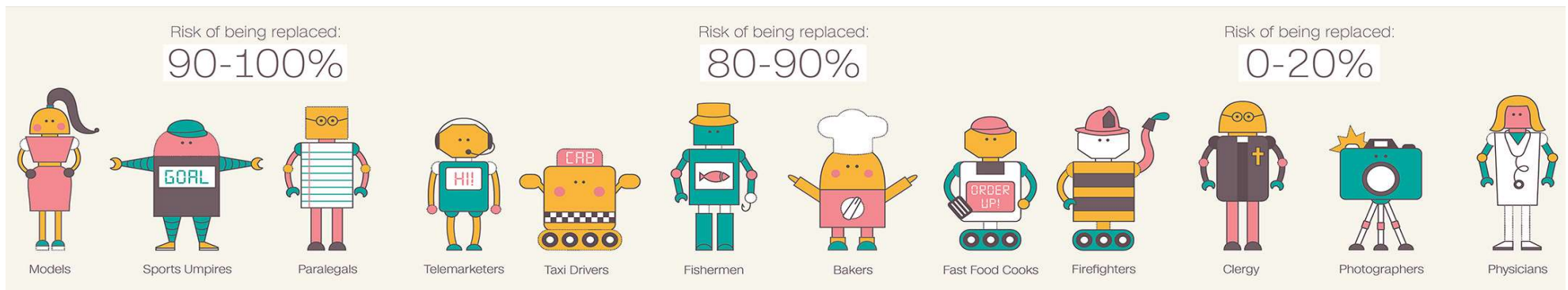
- ▶ “Working hand in hand with humans” or “replacing human labour”?
- ▶ Beyond industrial robots: service robots introduced in a growing number of areas and activities
- ▶ Automotive sector as the first one with major impact (due to “connected & autonomous driving”)



Robots and Industry4.0: Impact on Jobs

2016 Study on European Civil Law Rules in Robotics, commissioned by the European Parliament

- ▶ “If robotization picks up speed, it could wipe out several million jobs across Europe, and not only low-skilled jobs” [...] Robotisation and relocation of industry needs to be planned to support rather than supplant people in the workplace”
- ▶ “After the initial job losses, new jobs will then emerge”, but “we risk seeing a lost generation of people trained for jobs unable to find a job matching their skill set”



- ▶ *Smart Robots could soon steal your job, CNN Money, 15/1/2016*

Defining Robots

- ▶ **A general definition of robot is challenging**
- ▶ **Characterise robots by features (Robolaw Project)**
 - ▶ *Use/Task*: two large categories – industrial and service robots
 - ▶ *The environment where the robot operate*: physical, virtual
 - ▶ *Nature*: embodied or disembodied (virtual agent, bot)
 - ▶ *Human-Robot Interaction*: interface, communication form
 - ▶ *Autonomy*: tele-operated, semi-autonomous, fully autonomous

Social Robots

- Social Robots are a special type of service robots with advanced capabilities in interacting and communicating with humans
- Robot companions (embodied)
- Intelligent agents, virtual assistants (disembodied)



Paro



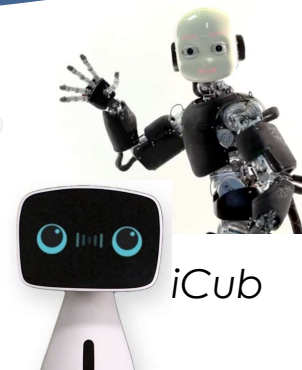
Genibo



Asimo

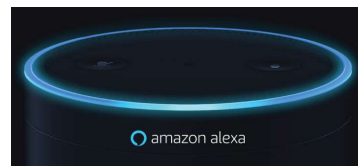


Nao



iCub

Aido



Alexa

What can I help you with?

Siri



Cortana



Google Assistant



In-Car Virtual Assistants

Industrial vs Service (Social) Robots

Issue	Industrial Robots	Service (Social) Robots
Sphere of Action	Semi-Public spaces i.e. factories (i.e. Industrial Production)	Private / Social space (i.e. Social Reproduction)
Main Purpose(s)	<ul style="list-style-type: none"> - Improve quality of products and efficiency production processes (<i>competitiveness</i>) - Taking care of dangerous and/or repetitive tasks/jobs (<i>better working conditions</i>) 	<ul style="list-style-type: none"> - Maintaining/Improving Quality of Life Standards in e.g. Health Care, Education, Transport, Leisure - Enhance accessibility and affordability of services (especially for “weak” social groups) - Making better use of own time
Introduced & Accepted by	Company & Trade Unions (affects workers' conditions and wages. May imply job losses)	Public Institutions first Then Private citizen / Service Provider
Controlled by	Factory Managers / Workers	Private citizen / Service Provider
Regulated by	Workplace policies & Labour laws	Public policies and laws (e.g. civil law)

The Self-Driving Car, a mix of Industrial and Service Robot

Issue	Self-Driving Cars
Sphere of Action	Public Spaces (e.g. roads)
Main Purpose(s)	<ul style="list-style-type: none"> - Improve safety of roads (Taking care of dangerous and/or repetitive tasks) - Enhance accessibility and affordability of services (especially for “weak” social groups) - Making better use of own time
Introduced & Accepted by	Public Institutions first. Automotive Industry in partnership with ICT companies Role of trade unions? (may imply job losses for transport sector e.g. truck and taxi drivers) Private citizen
Controlled by	Service provider Private citizen (user)
Regulated by	Workplace policies & Labour laws Public policies and laws (e.g. civil law)

The Place for AI in Autonomous Driving

- ▶ **To what extent is AI needed in self-driving cars?**
- ▶ AI mostly used in autonomous driving functions (i.e. the “Industrial Robot” view)
- ▶ How about AI is needed in “social robot” functionalities?
 - ▶ These deal with sensitive personal data, complex social interactions and variety of purposes
 - ▶ More complex to regulate from an ethical and legal viewpoint
- ▶ **Shall we limit AI to achieve just “Operational autonomy”** (linked to safety functions only) or broader autonomy (i.e. the “sentient” car)?



Automated Driving Standards are about “safety-related” functionalities

- Five levels (SAE Int. Standard)
- Level 1-2: Assisted Driving
- Level 3: Semi-Automated (current state of the art)
- Level 5: fully autonomous (in respect to driving functionalities)

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system (“system”) monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

Self-Driving car as Social Robot: various approaches and products

- ▶ Unlike safety-related functionalities, “social robot” features of self-driving cars are completely unregulated and based on proprietary systems, different views and approaches
- ▶ Two broad categories of “social” features/functionalities
 - ▶ **In-Car Virtual Assistants:** integration of existing virtual assistants (e.g. Siri, Cortana, Alexa, Google Assistant) or implementation of ad-hoc ones. They support safety-related functionalities, but not only...
 - ▶ **Roof-mounted displays** for communication (possibly, language independent) to people outside the car (e.g. pedestrians)

Communication Displays (by Drive.ai)

- ▶ Roof-mounted communication Display through which the self-driving car communicates its intentions/plans to people outside the car (typically pedestrians)
- ▶ Language-independent: communication via emoticons
- ▶ Also supporting safety-related objectives, but it could also be used for other purposes, such as supporting “shared mobility” schemes (e.g. also driveless robo-taxis, being developed by Uber)



In-Car Virtual Assistants

“Car Makers choose virtual assistants” (BBC News, 6/1/2017)

- ▶ Safety-related functionalities
- ▶ Customised infotainment
- ▶ Gateway to IoT (e.g. home control)



Gateway to IoT (e.g. home control)



- ▶ Virtual Assistant not only as human-car interface, but as access point to “everything”

Customised Infotainment



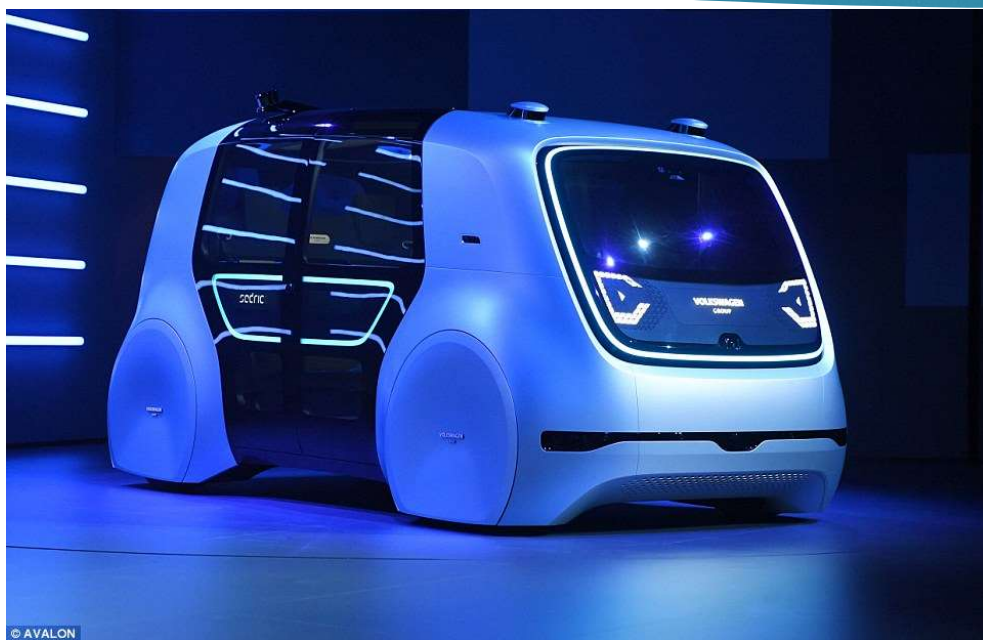
- ▶ “IoT Connected Cars and Virtual Assistants make life simpler”

(Vision of Nuance, IT company specialized in voice/natural language processing)

Recent Strategic Developments

Automotive Companies	Virtual Assistant
Mercedes-Benz, Daimler, Hyuandai	Google Assistant
BMW, Nissan	Microsoft Cortana
Ford	Amazon Alexa
General Motors	IBM Watson
Toyota	Yui
Honda	HANA (Honda Automated Network Assistant)
Most car manufacturers (including the ones above)	SIRI (via Apple CarPlay app)

Volkswagen Sedric (concept car), your personal robot chauffeur



- An electric car run by AI, controlled via voice or smartphone and with a huge windscreen

View of Self-Driving Cars ('60s)



ELECTRICITY MAY BE THE DRIVER. One day your car may speed along an electric super-highway, its speed and steering automatically controlled by electronic devices embedded in the road. Highways will be made safe—by electricity! No traffic jams... no collisions... no driver fatigue.



NO-HANDS DRIVING is easy with wheel-less car—roadway groove holds it on course. Electronic controls would be needed only at junctions.

68 POPULAR SCIENCE AUGUST 1961

- ▶ **Vision has not changed much over the years...**
- ▶ **Value of Time:** what will we do with the time previously spent driving?
- ▶ **Freedom of choice:** How about those who enjoy driving?

Social Robots, AI and Self-Driving Cars

- ▶ **Car manufacturers and ICT companies establishing strategic partnerships** and investing much into “connected and autonomous driving”, seeing the car as a gateway to IoT
- ▶ **Self-Driving Cars turn into Social Robots**, thanks to an algorithmic AI “brain”, a big data “memory”, a “voice” (virtual Assistants) and “gestures” (communication displays)
- ▶ **Too early to judge possible impact, but a few considerations**
 - ▶ No common approach on role of AI, apart on its use in safety-related functionalities
 - ▶ Commercial solutions seem generally optimized for a “car ownership” scenario
 - ▶ Predominant technological positivism generating a rhetoric around “connected and autonomous driving”

Social Robots in Human Societies

- ▶ ***“It is essential that the big ethical principles which will come to govern robotics develop in perfect harmony with Europe’s humanist values”***

(2016 Study on European Civil Law Rules in Robotics, commissioned by the European Parliament)

- ▶ ***“Reflect on what kind of society we want to build and live in. This includes the robots we build and use, and tells us about the model of our society”***

(“Situating the Human in Social Robots. In Vincent, Taipale, Sapio, Lugano & Fortunati (Eds.). Social Robots from a Human Perspective, Springer 2015”)

Thank you for your attention!

Question Time

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