

# CS26020

## Robotics and Embedded Systems Issues

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Imagine something happens.....



# Robotic System Issues

- Transparency
  - Explanations available
- Standards
  - All standards embody a principle
  - Ethical Standards
  - ISO and IEEE etc
- Ethics
  - Ethical implications of technology

# Transparency in Autonomous Systems?

- Possible to discover why it behaves in a certain way
- Why it made a particular decision
- Explainable in plain language to be understood by non-experts

# Why is transparency important?

- All robots are designed to work for/with humans
  - They need to understand what they are doing and why
  - Without this, those systems will not be trusted
- Robots can and do go wrong
  - Very important that we can find out why
  - Without transparency, finding out what went wrong is difficult



# Transparency for Accident Investigation

- What information does an accident investigator need to find out why an accident happened?
  - Details leading up to the accident
  - Details of internal decision making process in the robot
- Established and trusted processes of air accident investigation provide an excellent model of good practice for autonomous systems
  - Aircraft black box (flight data recorder)

Standards are infrastructure.....



# Standards

- Safety
  - Follow general principles
- Quality
- Interoperability
  - Standard ways of doing things benefits all
- All standards embody the values of cooperation and harmonisation

All standards are implicit ethical standards



# Robot Ethics

- Understanding the ethical implications and consequences of robot technology
  - Robotics
  - Computer Science
  - Psychology
  - Law
  - Philosophy
- Questions about developing and deploying robotic technology in society

# Robot Ethics

- Where is the main impact?
  - Interaction with humans
    - Military
    - Care for the elderly
    - Medical
    - Search and recovery
    - Entertainment robots
    - .....

# Hazard risks and mitigation

			happened	
Deception (intentional or unintentional)	Confusion, unintended (perhaps delayed) consequences, eventual loss of trust	Avoid deception due to the behaviour and/or appearance of the robot and ensure transparency of robotic nature	–	Software verification; user validation; expert guidance
Anthropomorphization	Misinterpretation	Avoid unnecessary anthropomorphization Clarification of intent to simulate human or not, or intended or expected behaviour	See deception (above) Use anthropomorphization only for well-defined, limited and socially-accepted purposes	User validation; expert guidance
Privacy and confidentiality	Unauthorized access, collection and/or distribution of data, e.g. coming into the public domain or to unauthorized, unwarranted entities	Clarity of function Control of data, justification of data collection and distribution Ensure user awareness of data management and obtain informed consent in appropriate contexts	Privacy by design Data encryption, storage location, adherence to legislation	Software verification
Lack of respect for cultural diversity and pluralism	Loss of trust in the device, embarrassment, shame, offence	Awareness of cultural norms incorporated into programming	Organizational, professional, regional	Software verification; user validation
Robot addiction	Loss of human capability, dependency, reduction in willingness to engage with others, isolation	Raise awareness of dependency	A difficult area, particularly in relation to vulnerable people Careful evaluation of potential applications is needed	User validation; expert guidance



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## The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems

An incubation space for new standards and solutions, certifications and codes of conduct, and consensus building for ethical implementation of intelligent technologies



### INDUSTRY CONNECTIONS

The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems

Videos & Webinars

News & Events

Ethically Aligned Design, Version 1, Translations and Reports

Download Ethically Aligned Design, Version 2

**VIEW THE COMPLETE LIST**

### ABOUT

To ensure every stakeholder involved in the design and development of autonomous and intelligent systems is educated, trained, and empowered to prioritize ethical considerations so that these technologies are advanced for the benefit of humanity.

- [View specifics regarding the Mission and deliverables for the Initiative.](#)
- [See a list of The Initiative's Executive and other Committees.](#)
- [Learn more from Frequently Asked Questions.](#)

### ETHICS IN ACTION

We've launched the second version of *Ethically Aligned Design*! [View Launch Details.](#)

#### Ethically Aligned Design, Version 2

*Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems (A/IS)* represents the collective input of several hundred participants from six continents who are thought

# Case Study – Driverless cars





# SAE levels of driving automation

- Level 0: warnings issued, little intervention
- Level 1: “hands on” eg cruise control, parking assistance, lane assist – human in control of some aspect
- Level 2: “hands off” automated control of full system – but driver prepared to intervene at any time
- Level 3: “eyes off” driver can watch DVD but be prepared to intervene within some timescale
- Level 4: “mind off” driver may go to sleep though could retake control
- Level 5: “steering wheel optional” no human intervention possible

# Sensors

- Lidar
- Stereo vision
- GPS
- IMU (inertial measurement unit)
- May use sensor fusion (why?)

# Control?

- SLAM (Simultaneous Localisation and Planning)
- SLAM with detection and tracking other moving objects
- Machine Vision
- Deep learning neural nets

# Some Technical Challenges

- Car navigation
- Localisation of vehicle
- Mapping
- Map matching
- Global Path Planning
- Environment Perception
- Perception of speed and direction
- Vehicle control

# Why do we want driverless cars?



# Why do we want driverless cars?

- Fewer deaths
- Mobility for blind, disabled etc
- Better road usage and economy
- Economy?

Why not?

# Why not?

- Used as weapons
- How would bikes, pedestrians react?
- Job losses
- More travel?
- Who takes responsibility on an accident
- How do you program decisions – drive on pavement etc?
- Psychology of driverless cars....

# Issues?

# Issues

- Software in cars already unreliable
- Cyber attacks
- Software updates and maintenance
- Reliability in all weather and road conditions
- Ethical issues
  - Protect passengers or wall?
  - Collide with car or person?
- Liability for accidents?



So when do we get driverless cars in  
Aberystwyth?

# Summary

- Need to start thinking about integrating the following into our robotic systems from the design stage:
  - Transparency
  - Standards
  - Ethics