

The Imminent Challenges of Autonomous Vehicles and How To Ethically Address Them

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Part I

What are autonomous vehicles?
What is the history of autonomous
vehicles and state of the art?
Current regulatory bodies



Part II

Problems in driver-vehicle
relationships.
Problems regarding infrastructure.
Problems regarding the job market.



Part III

Finding ethical solutions to these
problems.

Introduction

- Autonomous technology
 - technology that has the capability to drive a vehicle without the active physical control or monitoring by a human operator (State of California DMV)
- Examples: Cruise control, emergency braking, lane centering
- Diverse industry applications
- Safety incentive
 - 1.25 million death/year; 3,287 deaths/day related to car crashes
 - 20-50 million are injured or disabled
- Economic incentive
 - \$518 billion in costs annually related to car crashes



SAE Levels of Autonomy (Level 0 – 2)

SAE Level 0 – No Driving Automation

- Vehicle control is dependent entirely on the human driver;
- Lane departure warnings and emergency braking

SAE Level 1 – Driver Assistance

- A vehicle provides driver assistance in **either** lateral or longitudinal control
- Lateral: steering
- Longitudinal: acceleration and braking
- lane centering or adaptive cruise control

SAE Level 2 – Partial Driving Automation

- **Both** lateral and longitudinal control

Each of the levels require driver to be present and constantly monitoring these systems

SAE Levels 3- 4

SAE Level 3 – Conditional Driving Automation

- Complete control steering, acceleration and braking **under certain conditions**
- Constant driver monitoring not required
- Ability to intervene is required

SAE Level 4 – High Driving Automation

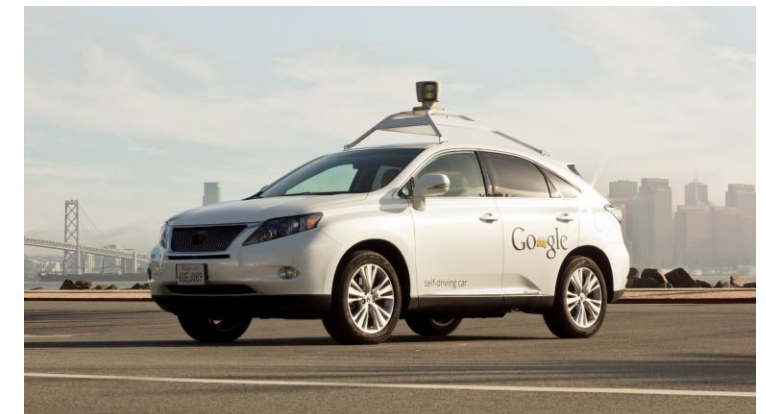
- Complete autonomous control and does not require user to monitor or intervene
- Ability to navigate **within a constrained geographical area**

SAE Level 5 – Full Driving Automation

- Complete autonomous control and does not allow the driver to intervene
- Can navigate on any public road under any conditions

History

- University laboratories
 - Todd Jochem
 - 2,797 miles from Pittsburgh to San Diego
 - Ernst Dickmanns (Germany)
- DARPA Grand Challenges
 - 2004 Grand Challenge
 - \$1 million dollar prize; no winners
 - 2005 Grand Challenge
 - \$2 million dollar prize; 5 teams completed obstacle course; Stanford University took first place
 - 2007 Urban Challenge
- Companies begin to take interest
 - 2009 Google secretly began developing its own AV



Major Players

- Waymo
 - Taxi-like services
- Tesla
 - Personal AV; currently in market
- General Motors
 - Taxi-like services; classified as the top leader in industry
- Major car manufacturers heavily investing into their AV departments
 - Ford, Mercedes, Honda, Chrysler etc.



Regulatory Bodies

- United States Department of Transportation (DoT)
 - National Highway Traffic Safety Administration (NHTSA)
 - safety standards of AV and AV technology found within all transportation vehicles
 - Federal Transit Administration (FTA)
 - authority over public transportation
 - The Federal Motor Carrier Safety Administration (FMCSA)
 - regulates commercial motor vehicles operating in interstate commerce
- Europe
 - Centre for Connected and Autonomous Vehicles (U.K.)
 - Investments with industry
 - Federal Ministry of Transport and Digital Infrastructure (Germany)
 - Researching prioritization of human life; private data
 - European Commission
 - Initiatives to research overlapping technologies like 5G, cybersecurity, privacy and free flow of data



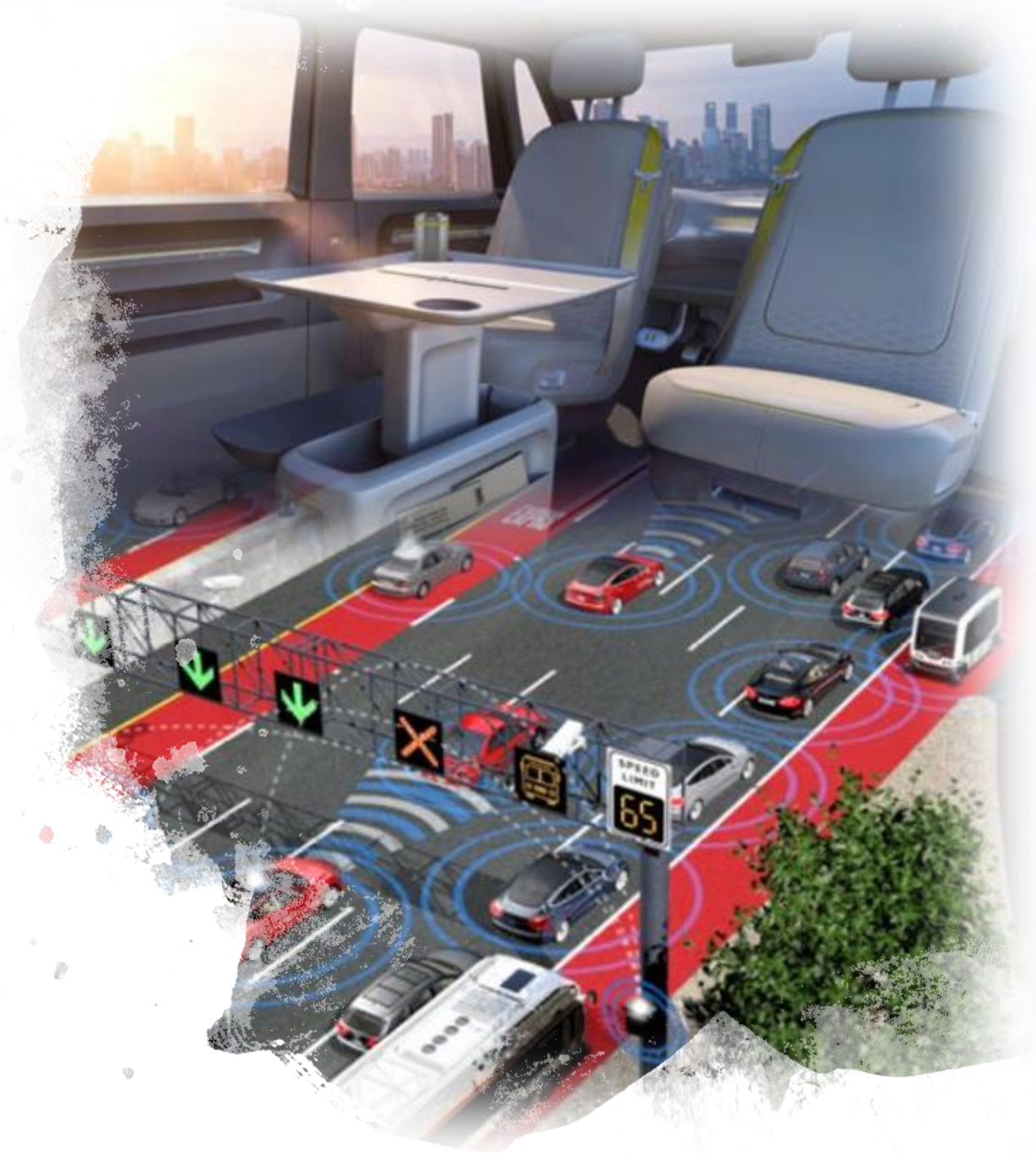
Vehicle Driver Relationship

- Generally less acceptance for AV with higher levels of autonomy such as SAE Level 4 and Level 5.
 - Indicative of speculation when regarding safety
- Not always the case =>
 - Problem of overreliance on the system
 - How well are capabilities understood
- perceived level of acceptance varies more specifically between the specific AV technologies used
 - Navigation Assistance high
 - Blind-Spot Warnings low



Infrastructure

- Types of AV on the road
 - Private AV
 - Taxi-like services
 - Public transit AV
- AV will redefine what can be done while transportation is used
 - 77% and 69% of public transit users report to never work
- Currently only 41% of US roads meet the requirements for a “good ride”, influenced by things such as potholes and poorly marked roads
- Increased accessibility to automobiles increases emissions
- Modifying curves and sidewalks for public transit users and pedestrians
- Relocation of parking spaces



Jobs

- After 2000 over 5 million jobs were lost, with 80% of these jobs being due to automation
- Up to 15.5 million jobs could be affected by the introduction of AV
 - 3.8 million – jobs where driving is primary action
 - 11.7 million – jobs that deliver services/travel for work
- Industries will need to address worker retraining
- Truck driving industry
 - 5.2 million other jobs
 - Generally not concerned with autonomous trucks taking over their job



Addressing Vehicle Driver Relationships

- Invest in driver-education
 - License for operating within an AV
 - Require automobile manufacturers to educate drivers on their capabilities
- Invest into driver monitoring
 - Cadillac has implemented a multi-camera monitoring system
 - Use methods to predict driver behavior
- Give users autonomy in selecting AV features



Addressing Infrastructure Needs

- Adapt to needs of users
 - Provide mediums that passengers can utilize
 - Public offices, special features for people with disabilities
- Incentivize shared AV
 - Shared ride services and public transit options
 - Make AV widely accessible (not just affluent users)
- Rebuild existing infrastructure
 - Fix infrastructure detrimental to AV
 - Partner with industry to modify infrastructure so that it can support AV technology
- Reutilize old parking spaces for social use
 - Green recreational spaces, assist public transport infrastructure
- Incentivize policy that is favorable towards environmental sustainability
 - Shared services can decrease congestion, decrease emissions
 - Decrease dead handling by reducing parking costs





Solutions for the Job Market

- Slowly integrate use of AV into jobs
- Incentivize use of AV that require human services
 - Public transit cleaning, disability services
- Retrain those with adequate background for technical roles
- Promote transparency
 - Employers with plans to implement AV technology should inform employees

Ethics in Proposed Solutions

- Ethics
 - choosing what is right and good through the application of morals
- The Constructivist Approach
 - Derives moral values from general conceptions of justices through deductive arguments based on hypothetical cases
- Autonomous vehicle technology is fundamentally developed for the public benefit
 - Public benefit drives choices in policy
 - Accessibility
 - Transparency
 - Safety
 - Safety nets

Sources

- All references for facts and figures can be found in my White Paper
- None of the background images used are my own. Refer to the following for image sources:
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