A Presentation on

Human Computer Interaction (HMI) in autonomous vehicles for alerting driver during overtaking and lane changing

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NHTSA: “Vehicles, in which some controlling functions are carried out w/o direct physical input.”

Sensing Environment through IR and Ultrasonic rays, image processing, global positioning system, RADAR etc.

The controller is designed to gather data from all units and analyze it thoroughly to find the perfect path for vehicle along with obstacles.
INTRODUCTION

- Controller should be capable of locating other cars on road travelling in same directions as well as in opposite directions with their respective velocities in order to avoid mishaps.

- Autonomous vehicles are future.

- Capable of reducing traffic and emissions in environment
Different levels of Automation

Level 0: No automation at all.

Level 1: Cruise Control, Park assist

Level 2: Adaptive cruise control, lane assist

Level 3: Automation for limited environments

Level 4: Unable to perform is severe conditions

Level 5: Enter destination. That’s all!!
Present Scenario

- Level 1 and 2: Set the mode and keep tracking with parallel actions.

- Comfortable and easy to use automation

- Need to increase the reliability in the system

- Not good for chaotic situations.

- More work is to be done for keeping the driver in the “loop”
Present Scenario

- Need to develop situational awareness

- Driver should be well aware of limitations

- First accident to Tesla’s car was due to sunlight

- There is only a button on the screen which flashes up if something goes wrong.

- Delays the requested action

- Passive fatigue during long travels
1) While Overtaking The Other Vehicle:

Overtaking is an important part of driving especially when it comes to autonomous driving.
- It calculates relative velocity along with changing current lane in order to avoid collision.

- Velocity of our vehicle should be increased in accordance with others

- Scenario can change drastically if error occurs

- Driver is required to pay attention at all the times during this scenario.
• This can be decreased by adding some features in HMI.

• To keep the driver in the loop all the calculation being made at the backend can be communicated to driver with help of HMI.
1.1 Use of Graphical Display

- The display can show live streaming of road map along with detected obstacles as well as other cars.

- The controller can also input lane status to the display.

- Highlight nearest cars in front of the vehicle and behind the vehicle along with their distance from vehicle and velocities.
1.1 Use of Graphical Display

- We can have new element added in this display as “operating radius”

- Space occupied by the vehicle if turned in any direction.

- If the obstacle is coming closer inside the operating radius it can be made flashy to win the attention.
Above figure shows the operating radius (Red circle) of the vehicle which is the space occupied by the vehicle if turned in all directions. Grey pentagon represents vehicle. Yellow lines are for lanes.
1.2 Voice Message

- For complete safety, we can add a voice message declaring an alert or an alarm for taking charge of the vehicle.

- We can set a dynamic or adaptive threshold distance from nearest vehicle, which, if crossed, triggers an alarm to driver for taking total control.
1.2 Voice Message

- Vehicle will be shifting from automated mode to normal mode as soon as driver takes the control which in-turn will give an accelerator and brake in diver’s command as well.

- While sending out a voice message through infotainment systems the pitch and volume level should be mainlined such that driver will give full attention to it.
Assigning control to driver should not be complicated

Stressful conditions can result in mishap due to delays in assigning control

Multiple ways should be kept to change the course of control.

Steering wheel, joystick, accelerator or brake pedal
2) While changing lanes:

Change of lanes often occurs while taking diversion, changing speed, overtaking another vehicle etc.
- Image processing is used to detect separators.
- Availability of lanes in on both the sides along with obstacles
- Alerting for wrong way
1.1 Use of Graphical Display

- Though live streaming is not required, we can have a system on user demand.

- Distance from obstacles on both the sides along with front and back clearance.

- If the clearance reaches minimum threshold user will be alerted by flashing that obstacle.
1.2 Voice Message

- First accident to Tesla’s autonomous car.
- “Lane not detected correctly”
- “Unclear obstacle in path”
- Increased reliability and winning the attention.
1.3 Flashing Button

- In addition to these features, we can have a button on screen with siren.
- This should be large in size and perfectly visible to user.
- Flashes when minimum threshold is reached.
- Handling control back to the driver will be same as of previous case.

- Use of voice commands is debatable.

- Infotainment system, Discussions in the car, noisy environment.

- Switch can be provided for turning on voice commands.

- This may produce delay in taking action.
Heuristic Evaluation

It is carried out to identify the problems in human machine interface. Jacob Nielsen’s principles are widely used in industry for checking HMI.

Visibility of the system: User should be aware of actions taken by the system. Proposed system increases visibility of the system.

User control and freedom: When driver is required to act he/she will be free to choose the way for taking charge of that vehicle.
Aesthetic Design: Design should be enough good to make user feel better and comfortable. Display along with voice messages can reduce fatigue by keeping user active.

Error prevention: Avoiding mishaps. Not preventing errors in system. “Keeping it in the loop”

Help users recognize, diagnose and recover from errors: Simple and clear message to reduce the delay in taking action.

Recognition rather than recall: Minimize the user’s memory load. “Voice commands” + Display
Challenges

- HMI signals should be fast. User actions are dependent on them.
- Multiple conflicts should be given priority dynamically. Overtaking on straight road versus on mountain road.
- The voice command from the system should be loud and clear.
- The voice command can be generated in multiple languages as user is not bound to understand one common language.
A new challenge can be critical.

Driver can set autopilot mode on in chaotic conditions if he loses control.

Just to blame automation!

Controller should identify the scenario before changing the mode.

This can be communicated with appropriate HMI signal.
Alerting system should be improved using combination of HMI techniques in Level 1, 2 and 3 of automation.

This will include new form of graphical display, voice messages and flashing buttons.

A new term of operating radius can be introduced on display.
References

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