Software Engineering Homework 4

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Given the problem that pedestrian deaths are caused by "collisions" or "Back-overs" while drivers are backing up their vehicles. To establish a set of requirements for this issue, we should identify where these collisions mostly occur, what people are typically the victims of these collisions, why these collisions occur, and how the injuries sustained.

Most of these accidents occur in residential driveways when vehicles are backing out. Many of the victims are between 1 and 3 years old and senior citizens. In all cases, the driver is unaware or is unable to react in time to avoid a collision once they become aware of the pedestrian obstacle. The pedestrian deaths are primarily caused by running over the pedestrian with the tire(s) or the body of the vehicle and not the impact itself. After identifying these underlying variables that are involved in pedestrian collisions, we can establish an informed set of requirements.

1) Improve preventive and safety measures in vehicles to decrease back over collision rates.

2) Improve alarm systems in vehicles that warns the driver of a collision while reducing false positives.

3) Collision prevention systems should work even in poor weather, lighting, and noise conditions.

4) Collision prevention systems should not override the driver’s control.

5) Collision prevention systems should be able to distinguish between obstacles and pedestrians.

To establish these requirements, we should also understand what the common technologies cars have for collision preventive measures and how they work with collision alarm systems. Some common technologies cars have for sensing pedestrians are radars, cameras, and LiDAR. Radar is the most reliable of the three and the least susceptible to poor weather. Cameras have good resolution and allow the driver to see their surrounding obstacles. LiDAR is able to give you a general sense of what shape the obstacles are, is not susceptible to poor lighting conditions, and has decent resolution. Whenever one of these technologies detect an obstacle close enough to the vehicle, it warns the driver with an alarm alerting them of the obstacle.

However, there are hardware constraints technologies that affect our requirements. Although these technologies significantly help prevent collisions, they are not fool-proof. Issues with radar are that it is not precise enough to be able to recognize obstacles and differentiate from them from pedestrians. Issues with cameras are that they are very susceptible to poor weather and poor lighting conditions. Issues with LiDAR are that it is very expensive and its reliability is mostly unproven.

Each of these collision prevention technologies have susceptibilities in some area that make it possible for the driver to collide with a potential undetected obstacle. Each of these susceptibilities in the previously stated technologies are an underlying factor as to why it is impossible to always be able to correctly distinguish an obstacle versus a pedestrian. It is also impossible to completely eliminate false positives as the alarms will sound even if the obstacle is not a pedestrian. Nevertheless, we should still strive to improve our collision detection systems so that we decrease the rate of pedestrian deaths.

One thing in common with the established requirements is that their main goal is to overall reduce the number of injuries and consequently establishes preventing injuries as a global invariant. However, by identifying and understanding what the requirement’s desired outcomes are, we able to establish other global invariants within the system.

One global invariant we can establish is improve safety for pedestrians from potential vehicle collisions. The goal of the first requirement is to reduce back over collision rates so it follows suit that by reducing collision rates, we are also increasing pedestrian safety. Another global invariant is to correctly warn the driver when a collision is inbound. The goal of the second requirement to keep the driver safe from obstacles so we must be able to accurately identify potential obstacles. The last global invariant is to correctly differentiate between obstacles and pedestrians. The overall goal of this system is to decrease injuries to both pedestrians and drivers which are desired goals from the requirements.

[1] B.Cheng “Requirements Modeling and Management”

[2] B.Cheng “Requirements Elicitation”

[3] A. Davies “How Do Self-Driving Cars See? (And How Do They See Me)?”