Functional Requirements

An ideal Pedestrian Backup System must allow the driver to remain constantly aware of hazards and potential hazards as they drive in reverse. The system described here is designed to meet current best practice standards as suggested by research and industry. For instance, the National Highway Transportation Safety Administration noted that according to their testing 90% of backup collisions are preventable with a 180-degree camera [1]. The NHTSA document also referenced research that suggested at least a 3.5-inch screen with high-quality output gave the best results [1]. Research has shown that a fisheye camera is the most useful for backup maneuvers due to the larger field of vision they provide that allows drivers to see objects approaching from the sides [2]. We propose a system that makes use of these components coupled with additional safety sensors and braking control modules.

1. Rear-facing HD fisheye camera
   1. Mounted in the center of the rear of the vehicle, horizontally.
   2. High field-of-vision to allow 180 degrees of visibility laterally and vertical visibility from the ground to one foot above the height of the vehicle.

2. HD Digital display
   1. Displays continuous feed from the camera.
   2. Overlays proximity information by overlaying colors on the image such that red parts of the image are within a foot of the rear bumper, yellow parts are within 5 feet, and green areas are greater than 5 feet away.
   3. At least 3.5 inches (measured diagonally) of usable display.

3. Object detection sensors
   1. Detects objects within 2 feet of rear sides.
   2. Detects objects within 5 feet of the rear.
   3. Can measure the distance to objects.
   4. Sends signals at each time step.

4. Brake Control Module
   1. Completely halts vehicle when an object is detected within 1 foot of rear of the vehicle.
   2. Engages brakes within .001 seconds when triggered.

5. Mechanisms for alerting driver
   1. In-wheel vibration motor.
   2. In-dash LEDs.
   3. An audible signal through the sound system.

6. Override button
   1. When pushed puts the system in "Unsafe" state. In this state, the vehicle may continue to reverse even if the system detects an imminent collision.
2. Exits "Unsafe" state and returns to "Normal" state when the transmission leaves the Reverse position. In "Normal" state the system is active and can prevent collisions.

7. Control Unit Hardware
   1. Receives signals from all sensors at each time step.
   2. Provides connections to all alert mechanisms.
   3. Triggers Brake Control Module.
   4. Is controlled by software.

8. Software
   1. Real-time system.
   2. Predictive collision avoidance system.

Non-functional Requirements

Recent system designs have begun to emerge that provide enhanced collision avoidance features, many that anticipate potential collisions [3,4]. It is thought that these types of systems aid the driver by providing extra "situational awareness" [3]. While extra situational awareness is certainly warranted, we want to be careful not to distract the driver too much from the task of operating the vehicle. It is important that this system provides the above specified functional requirements, but should also be unobtrusive and easy to use, as indicated by the non-functional requirements below.

1. Rear-facing HD fisheye camera
   1. Must provide high-quality video.
2. HD Digital display
   1. Must play video from camera continuously and smoothly.
3. Object detection sensors
   1. Must not be affected by weather or other environmental factors.
4. Brake Control Module
   1. Must provide for smooth deceleration, and not sudden stops.
5. Mechanisms for alerting driver
   1. Must not impede driver's senses.
   2. Must be easily visible and stand out from surroundings if visible.
   3. Must mute audio system when the audible alarm sounds.
6. Override button
   1. Must be easy to reach and use.
7. Control Unit Hardware
   1. Must operate quickly enough to react in adequate time.
8. Software
   1. Accurately and quickly predicts possible collisions.
Bibliography


