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Power wheels modification to provide supported and autonomous driving capabilities - a preliminary study

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Abstract

Power wheels, as how commonly children's electric vehicles are referred to, are relatively inexpensive electric driving platforms built in scale that allows utilization of sensors designed for full scale cars. Space available and load carrying capacity is sufficient for prototyping and holding measurement components, while compared to full-sized car they are considerably cheaper, and provide far more real-car experience as compared to toy size robotic platforms.

Electric children's vehicles are especially popular in the United States, but also in Europe they seem to have constantly growing customer group. Majority of such vehicles are built on the same drivetrain components with brushed DC motors driving individual wheels through 3-stage gearboxes. Such solution results in 2-, 4-, and even 6-wheel drive vehicles with power per motor ranging from 25 to 120W. Top speed of such constructions is limited and does not exceed 10km/h. Most currently available cars can be operated in manual mode when child uses just accelerator pedal and steering wheel to control direction and speed, and in a remote-controlled mode, where parent can takeover control fully overriding children's controls. In the remote-control mode, the steering is moved by a DC motor which position is only limited by mechanical system constrains and motor torque. Such rides are often also available as a service in entertainment parks then on a single track usually not more than 2 cars are allowed.

Power rides have only three basic safety features available: first is remotely activated electric hand brake – realized by shortening motor terminals together and disabling throttle control from a child. This feature allows to stop such car within 1m distance; secondly steering override allows to turn the steering with a remote control; finally, in case battery is empty, gets disconnected by any failure, or car is powered down, the motors are put in braking mode and car is brough to a stop by shortening motors which provides hand brake functionality that is battery independent.

Nevertheless, children operating such cars are always capable of crushing into pedestrian, obstacles, or other similar type of vehicles if guardians are not careful [1]. Supervision of multiple children in same area can be challenging. Driving on longer distances is also something requiring significant attention of guardians that need to correct children's movements or take over control if child gets tired of controlling. Use of the cars in driving tracks limits usage of multiple vehicles in a single track due to the need of separate guardian/operator supervision on individual car to avoid accidents, limiting the potential and throughput of such tracks. Children's' vehicles are also often modified to provide rehabilitation help and mobility for special need children [2], then assistive technologies are of the paramount importance. To address those issues the following autonomy functions are required:

- Distance control to the preceding vehicle,

- Automatic emergency braking before obstacles,

- Distance preservation on sides of the vehicle to obstacles/other vehicles,

- Following track and pedestrian road in autonomous mode,

- Active prevention of the vehicle going off the predefined track or pedestrian path,

- Turning around and parking as one button press functions for helping smaller children to ride independently.

Additionally, to ease remote control visual gesture recognition, basic voice recognition, person/vehicle following functions are useful. This presentation shows concept of vehicle instrumentation and system level design as well as preliminary results of data collection from such instrumented vehicle.

Keywords: Autonomous driving, vision, sensing, electric drive, control

References

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