Development Of Ultra Sonic Sensor Driven Automatic Vehicle Reverse Safety System

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Abstract: The vehicle performance has been continuously improved and the study results relating to the safety of car driving have also been continuously reported and demonstrated. Currently, this project focusing in safety of the vehicle which is to develop the prevention systems during vehicle reverse mode using by Arduino controller, linear actuator and ultrasonic sensors. There are also additional features such as visible LCD to display distance measurement with obstacle and also a buzzer to alert or notify the driver. The main objective of this project is to enhance the vehicle safety during reverse mode. There are lots of cases reported in Malaysia because of the children(s) died after they was ran over by their parent's vehicle during vehicle reverse mode which the parents did not notice them. When the gear is shifted to the reverse mode, the sensors which located at the bumper of the vehicle automatically activate and detect the obstacle until 3.5 meter. If the system can detect obstacle less than 40 cm, automatically the braking system activate and the vehicle will stop immediately. At the same time the buzzer will alarm to notify the driver. This system can be installed to various types of vehicles which can avoid casualties and also to give confidence to the driver during reverse mode especially parking their vehicle in a small and narrow space. This system can be installed various types of vehicles.

Index Terms: Reverse mode, Prevention System, Safety.

I INTRODUCTION

Every year, thousands of children are killed or seriously injured because a driver backing up is invisible to them. A back-over incident typically takes place when a car is backing out of a driveway or parking space. According to the National Highway Traffic Safety Administration (NHTSA), more than 6,000 people are injured yearly by vehicles that are backing up. Of that number, 2,400 are children, and more than 100 of those children will die as a result of their injuries, according to the child-safety organization Kids and Cars. Furthermore, its shows that about 80% to 90% of women drivers are nearly less confidence when making reverse parking. Therefore, it would help by developing this prototype can be a method that can avoid the loss of life and enhance the confidence to drivers who want to park backwards.

II LITERATURE REVIEW

David G. Kidd and Andrew Brethwaite have done research on visibility of children behind 2010–2013 model year passenger vehicles using glances, mirrors, and backup cameras and parking sensors. Back-over crashes can result in severe and fatal injuries to pedestrians or people standing behind the vehicle. Based on data from the Not-in-Traffic Surveillance (NiTS) system, the Fatality Analysis Reporting System, and the National Automotive Sampling System General Estimates System, an estimated 18,000 injuries and 292 fatalities occur each year due to back-over crashes (Austin, 2008).About 2000 of these injuries were estimated to involve children younger than 5. Children are at a higher risk of being involved in a back-over crash because their shorter stature makes them harder to see. One factor that contributes to back-over crashes, especially those involving children, is vehicle rear visibility. Rear visibility is typically worse in larger vehicles like trucks and SUVs compared with passenger cars.

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Consumer Reports (2012) measured the distance from the vehicle's rear bumper to the location where a cone 28 in. tall was first observed by drivers 5 ft, 1 in. and 5 ft, 8 in. tall using glances over the right shoulder. The 28-in. cone was used to approximate the height of a 1-year-old child. For the 5-ft, 1-in. driver, the average rear sight distance was longest for pickups and shortest for minivans. Pickups also had the longest rear sight distance for the5-ft, 8-in. driver, and midsized sedans had the shortest. The blind zone for each vehicle and the average minimum sight distance without and with technology was calculated for each tar-get height and then aggregated among vehicles in each class. Table 3shows the average blind zone and minimum rear sight distance for all the study vehicles combined and by vehicle class for each target height. The average blind zone for the 30.2-in. tall object across all vehicles (240.24 ft2) was twice as large as the average blind zone for the 42.7-in. tall object (116.67 ft2). The average minimum sight distance for a 30.2-in. tall object (27.3 ft) was more than twice as long as the average distance for a 42.7-in. tall object (13.2 ft). The average blind zone and average sight distance for each vehicle class decreased as the target height increased. The smallest blind zone and average sight distance for each target height was observed among small cars. Large SUVs had the largest blind zone and average sight distance for each target height, followed closely by midsize SUVs. Eight vehicles were equipped with a backup camera system and a parking sensor system. The independent contribution of each technology to reducing blind zones was explored. Among these eight vehicles, the average percent reduction in blind zones for each target height provided by backup camera systems alone was about2–8 times larger than the percent reduction in blind zones provided by parking sensor systems alone (Table 4). Backup cameras alone reduced blind zones by 72–99 percent, and parking sensor systems alone reduced blind zones by 12–48 percent. The area detected by parking sensor systems was not completely redundant with the area visible using backup cameras. Across these eight vehicles, the average percent reduction in blind zone was 2–3 percentage points greater when using both technologies compared with reductions provided by backup camera systems alone. In conclusion, the results showed that rear visibility in terms of blind zone and average minimum sight distance was significantly poorer in larger vehicles compared with smaller vehicles and for shorter targets compared with taller targets. A taller object simulating the height of a 60–72-month-old child was easier to see than a smaller object simulating a 12–15-month-old child, but the taller object still was not visible up to 13 ft behind the rear bumper, on average. Backing technology significantly reduced blind zone and sight distance and minimized the effects target height and vehicle size had on rear visibility. Backup cameras nearly eliminated the blind zone behind vehicles, and parking sensors provided information that further increased rear visibility. Hence, backup cameras, as well as the combination of backup cameras and parking sensors, have the potential to substantially decrease the estimated 18,000injuries and 292 fatalities that occur annually in back-over crashes if drivers use the technology appropriately.

III Methodology

The development of this prototype divides into 3 stages, which are object detection, controller and linear actuator operated. Ultrasonic sensor will detect the distance vehicle during reverse parking from obstacle. If ultrasonic sensor detects any obstacle during vehicle reverse parking with certain distance, the sensor will send information signal to controller. Controller will give instruction to ARDUINO SHIELD for on the linear actuator and give high pressure to brake line and slow vehicle motion and stop the vehicle.

A. Block Diagram and Design of the prototype

Below the block diagram and design of the prototype of the Automatic Prevention System during vehicle reverse mode.

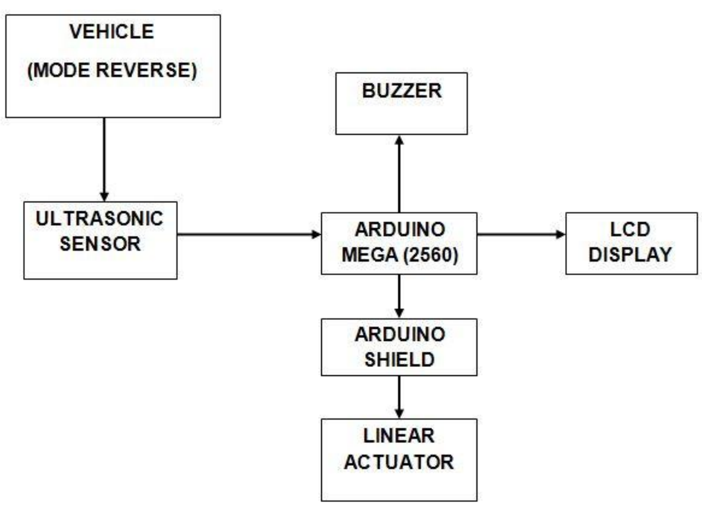

Fig. 1 *Block Diagram*

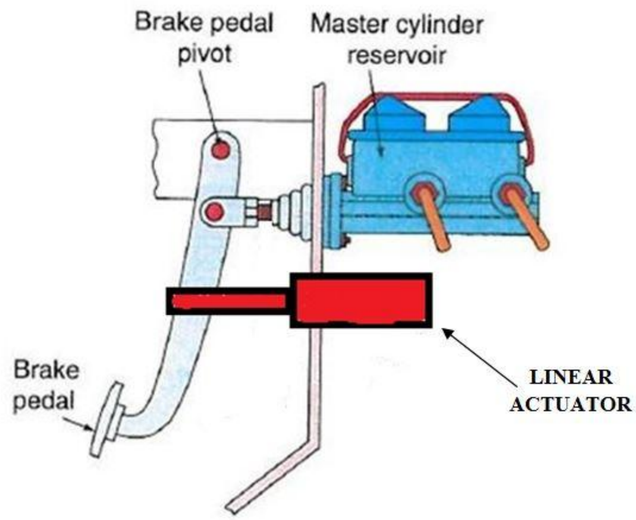

Fig. 2 *Prototype Design*

IV Result & Discussion

A. Results of System Operation

The ultrasonic sensor is an input device worked as obstacle detection and will triggered during vehicle reverse mode. When the gear shifted to R position this system will automatically activated. Then, the sensor will send the data to microprocessor Arduino MEGA 2560. The controller will sent information to LCD for display, to ON the buzzer to notify the driver and at the same time will control linear motor. Linear motor connected with the brake pedal to replace driver foot and this will slow down the acceleration of the vehicle. Table 1 below summarized the operation of the system.

Table 1: *Summarized of System Operation*

Sensor detected (cm)	Buzzer	LCD	Linear Motor	Brake Pressure
0-40	3 beep sound	Reverse Mode: Emergency Brake	On	High
41-80	2 beep sound	Reverse Mode	Off	Low
81-120	1 beep sound	Reverse Mode	Off	Low

When sensors detect obstacles at distances below the 40cm, the buzzer will start to alarm by sounding 3 beep and linear actuator which acts as a brake pedal will automatically slow down the vehicle. At this time, “EMERGENCY BRAKE” will appear at the LCD display. If the obstacle detected more than 40cm, automatically linear actuator will deactivated and during this time, “REVERSE MODE” will show at the LCD display. Every vehicle has a different force depending on the brake pedal of the master pump. In this experiment we are focusing on compact vehicle category type. We choose Perodua Viva model 660ex. The Engine types are EF-VE, DOHC, and 12V (4 Valves per cylinder) with DVVT while the main brake front using disc and rear drums. For this prototype we are using

SUNDOO MODEL SN-200 to simulate and to measure the force.

Table 2: *Perodua Viva Force at Brake Pedal*

No. of experiment	Test 1	Test 2	Test 3	Test 4	Test 5
Force (Newton)	155 N	197 N	199 N	250 N	240 N

B. Results on Obstacle Detection

This experiment was conducted to test the sensitivity of the sensor during night time and during the day. Table below shows the details of the distance detection before and after calibration of the sensor as tabulated in Table 3 and Table 4

Table 3: *Sensitivity of the sensor during the day time*

Distance (cm)	Actual (cm)	Percentage Error (%)	Percentage Accuracy (%)	After Calibration (cm)
120	115	4.67	95.8	120
110	105	4.54	95.45	110
100	95	5	95	100
90	85	5.56	94.44	90
80	76	5	95	80
70	66	5.71	94.28	70
60	56	6.67	93.33	60
50	46	8	92	50
40	37	7.5	92.5	40
30	31	-3.33	96.67	30
20	38	-90	10	20
10	37	-270	170	10

Table 4: *Sensitivity of the sensor during night time*

Distance (cm)	Actual (cm)	Percentage Error (%)	Percentage Accuracy (%)	After Calibration (cm)
120	115	4.67	95.8	120
110	105	4.54	95.45	110
100	95	5	95	100
90	85	5.56	94.44	90
80	76	5	95	80
70	66	5.71	94.28	70
60	56	6.67	93.33	60
50	46	8	92	50
40	37	7.5	92.5	40
30	30	0	100	30
20	37	-85	15	20
10	31	-210	-110	10

Based on the results of experiments that were conducted showed an increase in temperature can affect the sensitivity of the sensor ultrasonic.

V Conclusion

This project is to develop and improves the current braking system in order to prevent accidents during reverse mode. During reverse mode it will help driver sense when the objects are in the vehicle “blind spot” and automatically can prevent these type of accidents. This system can be applied to all types of vehicles on the road by just to do minor installation and spontaneously can be used by the user. With this system, it is estimated that accidents could be avoided especially children who like to play at the back of the car and suddenly appeared when her mother and father want to reverse parking. This system can also increase the confidence of the driver when reverse parking mode.

Acknowledgment

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