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A Review on Implementation of FPGA for Automatic Reverse Braking System

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Abstract: ***In this world automation of various systems have been designed just to reduce the time and human error. Vehicles, particularly four wheelers are very difficult to drive in the reverse direction. As personally one is very careful about, otherwise damage being caused to the vehicle. In view of this to provide a proper guidance to the vehicle in reverse direction, means are provided. Presently the vehicle has alarm system for maintaining the safe distance between vehicle and object while moving in reverse direction. When the vehicle gets too close to the object, the alarm is triggered this warns the driver about an object. But this feature has many problems and is prone to human error. We have enhanced the facility by using the same system but we have altered it so that the car brakes are applied automatically when an obstacle is close by. Our aim is to design the "Automatic Reverse Braking System" using FPGA(Field Programmable Gate Array)which can avoid the accident in reversing the heavy loaded vehicles like trucks, buses and all the vehicles consisting of braking system. For this purpose we have developed a model which consists of FPGA, obstacle sensors, sensing circuit which serves as the complete mechanism of automated braking system while reversing the vehicles to prevent collision between the vehicle and objects. If there is object in reverse path, the sensor senses the object and the break is applied automatically. In this, FPGA is used as a control unit to which the devices and sensors are interfaced. This system is suitable for commercial vehicles such as car, emergency services vehicles, trucks and buses.***

Keywords: FPGA, Control unit, sensors, sensing circuit.

1. Introduction

An automobile has been used to move human beings or as a carriers since the automobile was invented. Recently, the automobile is thought as daily necessasity because we spend much time with automobiles, such as we require it for emergency services, in factories, to carry loads etc.

The use of electronic components in automobiles is set to accelerate and with ongoing efforts to improve safety and comfort. Car makers in many countries have contributed to automobiles technology by developing systems such as rear view camera system, Road-to-vehicle and Inter-vehicle Communication Systems, auto-parking system , and new car technology for intelligent car such as intelligent transport system (ITS), hybrid car, electric car, and hydrogen fueled car Around 250 electronic components are presently being used in a cars..Therefore in this paper we propose a system which will help in enhancing the performance of vehicles and thus contributing to the upcoming automobiles technology.

The traffic accident is increasing as automobile production is increasing. It is important to prevent accidents so as to protect the driver, pedestrians, valuable properties when accidents are occurred. Many technologies have been developed for vehicles to avoid accidents while moving in forward direction. But when vehicles moves in reverse direction ,loads of problems are faced by drivers. Researches have been made on automatic braking systems, but we are introducing automatic brakes in reverse path. Generally a driver faces a difficulty in recognition of objects on reverse path, keeping this fact in mind here we are introducing a system. The system includes FPGA as a controller logic and the obstacle sensor to detect the objects. The module is designed on Finite State Machine (FSM), verified by Modelsim and synthesized by Xiling ISE.

Therefore, in this paper we propose an "Automatic Reverse Braking system" to prevent collision by using sensors to detect obstacles. The "Automatic Reverse Braking system" will process the sensor data and control the vehicle to prevent accidents caused by careless driving or difficulty in detecting objects in reverse path. In this paper, we designed the auto-braking system which keeps a distance between the object and vehicle to prevent accident using sensors and is fabricated using FPGA as a control unit and VHDL .

The system includes a novel technology to make vehicles safer and more efficient. The system is probably the most reliable means of detecting human beings and objects and, therefore, invaluable in the prevention of injury or fatal accidents. The aim of this paper is to develop an automatic braking system when the vehicle detects an obstacle in its reverse path.

Figure 1: Driver moving in reverse direction

2. Background Work

The aim is to design and develop a control system based on FPGA There have been considerable advances in modern vehicle braking systems in recent years. In automation field , designers have proposed several enhancements as follows.

1) Auto-Braking System for Pre-Crash Safety Using Sensor [6] was proposed to prevent front-end, rear-end, right-turn and left-turn accidents on roads.
2) Autonomous antilock braking system (ABS) system [5] which can take over the traction control of the vehicle either completely or partially was developed introducing control modeling procedure for a four wheel vehicle.
3) A precise short range radar for anti-collision systems [3] with automatic braking was developed for reverse protection on quarry vehicles.
4) A brake strategy for an automatic parking system [4] of vehicle was purposed including the brake controller design, simulation results and system validation.

Car makers are beginning to develop equipment for high-end vehicles with systems to sense roadway conditions using cameras, radar, sensors and such in an effort to avoid accidents. The traffic accident is increasing as automobile production has been increasing. It is important to prevent accidents and to protect the driver and pedestrian when accidents were occurred. All the above proposed design models contributed to safety of vehicles and pedestrians. It prevented rear end crashes , provided ABS for sharp turns or slippery roads. But all these are applicable for vehicles running in conventional direction, so we need to develop systems which enhances the performance and safety of vehicles when it moves in reverse direction. A model designed [8] on reversing of vehicles provided detection of obstacle , speed control mechanism based on binocular cameras. Thus, in this paper we propose an “Automatic Reverse Braking system” to prevent collision by using sensors to detect obstacles. The “Automatic Reverse Braking system” is processing the sensor data and controlling the vehicle to prevent accidents

3. System Architecture

The proposed auto-braking system has the sensor part to prevent an accident. The sensor embedded in vehicle will detect the obstacles using sensors. These sensors were operated all the time during driving in reverse direction. The processing part accepted the signal from sensors and processed the signals and generated the instructions and transferred the generated instruction to control unit of transmission and brake of vehicle.

3.1. Block Diagram

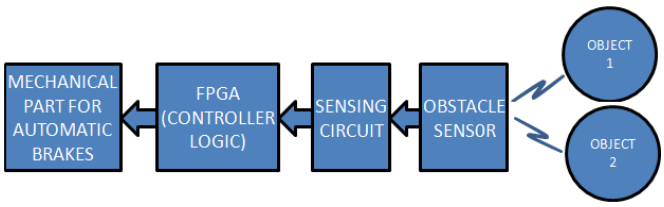


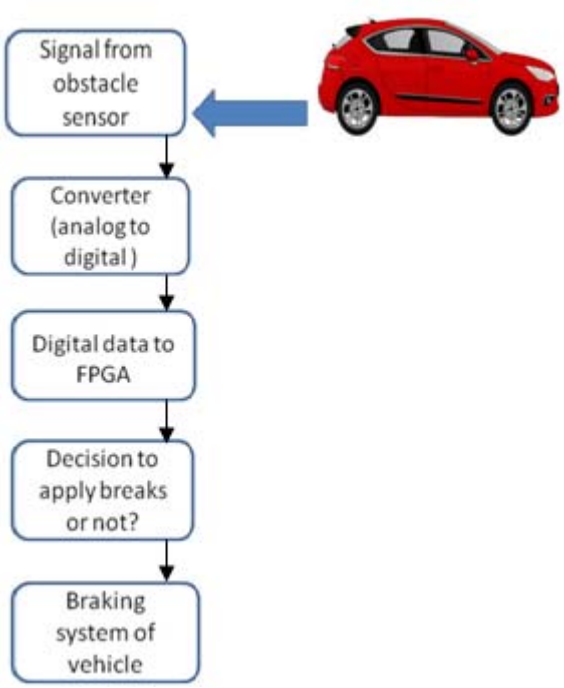
Figure 2: Block Diagram

3.2 System Description

The system includes a novel technology which can be fitted in commercial vehicles to prevent collision when vehicle moves in reverse direction. Implementation is done using FPGA (Field Programmable Gate Array) as a controller logic to which the sensors are interfaced.

- In this system sensor will detect the obstacle on the reverse path and send signal to FPGA.
- The output of obstacle sensor is in analog form, but FPGA requires data in digital form and hence we require a circuit called as Sensing circuit.
- Sensing circuit will convert the analog data into digital form , that is, the analog output of sensor is converted to digital and is given to FPGA.
- ADC is used as a sensing circuit.
- FPGA can be used to implement any logical functions that an ASIC could perform and has an advantage to update the functionality after shipping , reconfiguration of design and low non-recurring engineering cost relative to ASIC design.
- The behavior of FPGA is defined by VHDL. It acts as a controller logic is designed with the help of FSM, which will sense the object according the digital input and action will be taken accordingly.
- The output is provided by Switching circuits such as relays or LEDS.
- Practically, the final output is connected to mechanical system which is actually connected to breaking system of vehicle, which is responsible for applying brakes thus leading to the concept of automatic breaking. The following procedure is explained with the help of flowchart.

4. Flowchart



5. Conclusion

The whole system works only while reversing the vehicle. When the sensor senses any obstacle behind the vehicle, it sends signal to the control unit (FPGA). FPGA which act as a controller logic is designed with the help of FSM, which will sense the object according to the digital input and action will be taken accordingly. Thus we have developed an **"AUTOMATIC REVERSE BRAKING SYSTEM"** to prevent collision by using sensors to detect obstacles. The "Automatic Reverse Braking system" is processing the sensor data and controlling the vehicle to prevent accidents caused by careless driving or difficulty in detecting objects in reverse path. The system is probably the most reliable means of detecting human beings and objects and, therefore, invaluable in the prevention of injury or fatal accidents.

References

[1] Fletcher, I; Arden, B.J.B.; Cox, C.S., "Automatic braking system control," Intelligent Control. 2003 IEEE International Symposium..on,vol.,no.,pp.411,414, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1254670&isnumber=28053

[2] Wada, T.; Hiraoka, S.; Tsutsumi, S.; Doi, S., "Effect of activation timing of automatic braking system on driver behaviors," SICE Annual Conference 2010, Proceedings of vol., no., pp.1366,1369.

[3] Love, A B., "A precise short range radar for anti-collision systems with automatic braking," Consumer Applications of Radar and Sonar, IEE Colloquium on , vol., no., pp.4/1,4/6, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=243257&isnumber=6256.

[4] Chi-Chun Yao; Chia-Feng Lin; Kuang-Jen Chang, "A brake strategy for an automatic parking system of vehicle," Vehicle Power and Propulsion Conference, 2009. VPPC '09.IEEE , vol., no.,pp.798,802. http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5289766&isnumber=5289440

[5] T.K. Bera, K. Bhattacharya, A.K. Samantaray: Evaluation of antilock braking system with an integrated model of full vehicle system dynamics www.elsevier.com/ locate/simpat

[6] EungSoo Kim:"Fabrication of Auto-Braking System for Pre-Crash Safety Using Sensor" International Journal of Control and Automation.,Vol. 2, No. 1, March, 2009

[7] Carla Koike, Edward David Moreno: "A Control Design Approach for Controlling an Autonomous Vehicle with FPGAs" JOURNAL OF COMPUTERS, VOL. 5, NO. 3, MARCH 2010

[8] Zhang, Z.; Xu, H.; Chao, Z.; Li, X.; Wang, C., "A Novel Vehicle Reversing Speed Control Based on Obstacle Detection and Sparse Representation," Intelligent Transportation Systems, IEEE Transactions on , vol .PP, no.99, pp.1,14.