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Implementation of Automatic Reverse Braking System on FPGA

Divya Thakur **Prof. A. P. Thakare**

Abstract— **Automation technology have provided us with various systems that reduces 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 automatic braking when an obstacle is close by. 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 controlling logic is implemented on FPGA using Xilinx software. The system designed by VHDL keeps a distance between the object and vehicle to prevent accidents**

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

I. 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 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 Our aim is to design the "Automatic Reverse Braking System" when the vehicle detects an obstacle in its reverse path 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.. 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.

Fig1: Driver moving in reverse direction

II. LITERATURE REVIEW

There have been considerable advances in modern vehicle braking systems in recent years. In automation field , designers have proposed several enhancements. A precise short range radar system[1] was developed for anti-collision applications where automatic braking is applied in response to detection of a collision risk where a very high probability of detection is accompanied by a very low level of false alarms.

A brake strategy for an automatic parking system [2] of vehicle has proposed brake controller which work with the automatic parking system and make the process of parking smooth and stable.

Autonomous antilock braking system (ABS) system [3] which can take over the traction control of the vehicle is developed for a four wheel vehicle. ABS is a braking system that maintains control over the directional stability of the vehicle during emergency braking or braking on slippery roads by preventing wheel lock-up.

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Auto-Braking System using Sensor [4] was proposed to prevent front-end, rear-end, right-turn and left-turn accidents on roads. This module can detect the distance between front vehicle and driver's vehicle to keep a constant distance using a sensor and operate the brake system.

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

III. Proposed Work

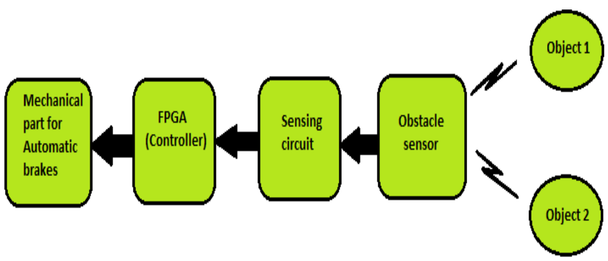

Fig.2. Block Diagram

The proposed auto-braking system consists of obstacle sensors embedded in vehicle which will detect the obstacles 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. The behavior of FPGA is defined by VHDL which 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 tail lights 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 IR (INFRARED) sensors are used as obstacle sensors in our system which are operated all the time while reversing the vehicle. The IR sensors consists of IR Transmitter and Receiver as shown in Fig.3

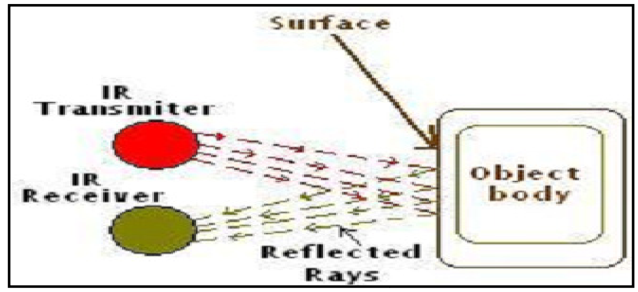

Fig.3: IR(Infrared) Transmitter and Receiver

Here as shown in fig.1the object can be anything which has certain shape and size, the IR LED transmits the IR signal on to the object and the signal is reflected back from the surface of the object. The reflected signals is received by an IR receiver.

In our system, Sensing circuit consists 555 IC which is used as astable multivibrator. The frequency of the 555 is tuned using the potentiometer as shown in fig.4.The output of 555 is given to the IR transmitter. TSOP detects a frequency of 38 KHz. The output of TSOP goes low when it receives this frequency. Hence the output pin is normally high because, though their LED is continuously transmitting, due to no obstacle, nothing is reflected back to the TSOP. The indication LED is off. When an obstacle is encountered, the output of TSOP goes low, as the required frequency is reflected from the obstacle surface.

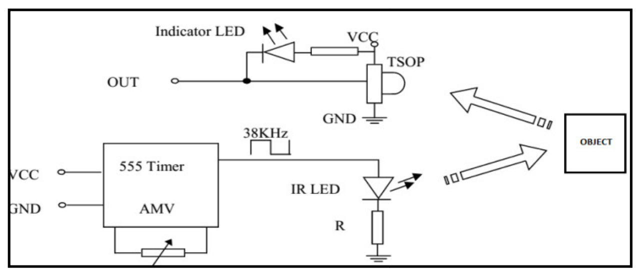

Fig.4: Schematic Diagram of Sensing circuit

The processing part in our system is FPGA (Field Programmable Gate Array) as a controller to which the sensors are interfaced. FPGA accepts the signal from sensors and process the signals and generats the instructions and transfers the generated instruction to control unit of transmission and brakes of vehicle. 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 designed with the help of FSM logic, which will sense the object according the digital input and action will be taken accordingly The final output is connected to mechanical part of braking system thus leading to the concept of automatic braking.

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IV. Results And Discussion

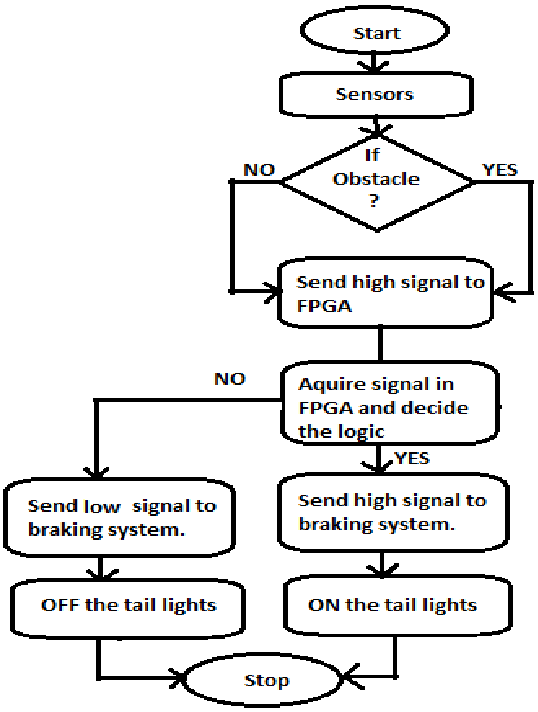

Fig.5: Operating Principle

The flowchart fig.5 represents an overall operation of system. When a vehicle moves in reverse direction ihe obstacle sensors senses ang send high signal to FPGA which acts as a controller, in which controling logic is embedded using Xilinx software. After the acquiring the signal FPGA decides the logic. If obstacle is present it will send high signal so that tail light glows on otherwise off. . The hardware implementation is shown in fig.6. It shows FPGA board connected to the obstacle sensors which is embedded in demo car.When obstacle is present, the tail lights connected to demo car is ON , pratically leading to the concept of automatic braking.

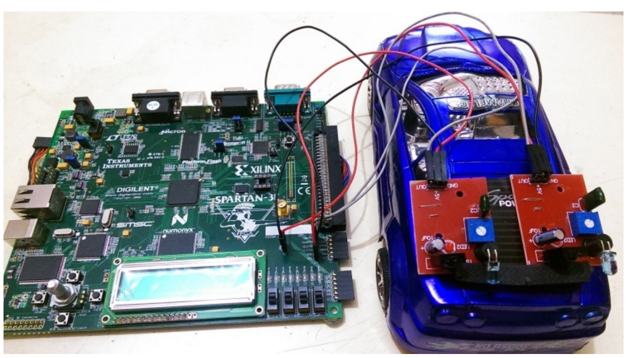

Fig 6: FPGA Board connected to obstacle sensors

In our system , TSOP module shown in fig.7 is fitted to the back side of vehicles which works when vehicle moves in reverse direction. TSOP module is combination of IR sensor and sensing circuit. The TSOP is a general purpose proximity sensor used for collision detection. The module consist of a IR emitter and TSOP receiver pair. The module consists of 555 IC, working in a stable multivibrator configuration. The output of TSOP is high whenever it receives a fixed frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware. The power consumption of this module is low.

Fig.7: TSOP Module

The TSOP module is than interfaced with FPGA board. The FPGA than processes the data received from TSOP module and decide the logic.

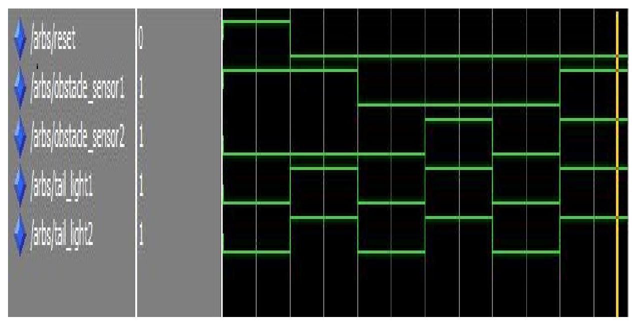

Fig 8: Simulation result

The simulation results of system is shown in fig.8, it shows the outputs of sensor1 and sensor2. The outputs of both the sensors are processed by controller and corresponding outputs (logic) are indicated by tail lights. When an obstacle sensor1 detects an object both the tail lights that is tail light1 and tail light2 glows on and if the obstacle is not present both the tail lights are off.

Fig.7 is the prototype module of the syetem. During actual implementation, the sensors will be embedded in the vehicles and will operate while reversing the vehicle. The tail lights in our prototype module glows on when an obstacle is detected which in practical implementation will initiate the braking system of vehicle leading to the concept of automatic braking.

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. For a future development of this project, the Logic Controller designed can be enhanced by applying more rules. By then, it can produce better response. The response should be better and can be applied to a real hardware model to observe the real response and yet can improve the system.

REFERENCES

[1] Love, A B., "A precise short range radar for anti-collision systems with automatic braking," Consumer Applications of Radar and Sonar, IEE Colloquium.
http://ieeexplore.ieee.org
[2] 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
[3] 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
[4] Eung Soo Kim:"Fabrication of Auto-Braking System for Pre-Crash Safety Using Sensor"
International Journal of Control and Automation. Vol. 2, No. 1, March, 2009
[5] 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,
[6] Carla Wada, T.; Hiraoka, S.; Tsutsumi, S.; Doi, S., "Effect of activation timing of automatic braking system on driver behaviors," SICE Annual Conference 2010
[7] 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 .

Journal Impact Factor-2.02
Indexed by- ProQuest, DOAJ and many International Bodies.