10 GHz Doppler Radar for Automotive Applications

Chandana K
M.Tech Student, DCN, Dept. of ECE,
GSSSIETW, Mysuru.

Jyoti B
Assistant Professor,DCN, Dept. of ECE, GSSSIETW,
Mysuru.

***Abstract* - Road safety is an issue of worldwide concern on human life and property. The development of collision avoidance system is the improvement in which it can bring out vehicular safety. The collision avoidance system consists of a radar sensor which is installed in the vehicle undergoes constant scanning. If any obstacle found on the road, it sends the signal to the driver in the form of warning. The signals obtained from the radar sensors will be in low pulse repetition frequency(PRF). Hence the signals from radars undergo filtering process to achieve high accuracy.**

Keywords: Collision avoidance System, Doppler radar, PRF.

I. INTRODUCTION

In the recent years, approximately 1.24 million people around the world die on roads and between 20 and 50 million withstand non-fatal injuries. If the current trend continues, road accidents are predicted to increase by 65% and become the fifth major cause of death by 2030. Driver inattention, fatigue and immature behaviour are the main factors causing road accidents [1]. Almost 50% of the accidents which involve inattentiveness are due to driver distraction.

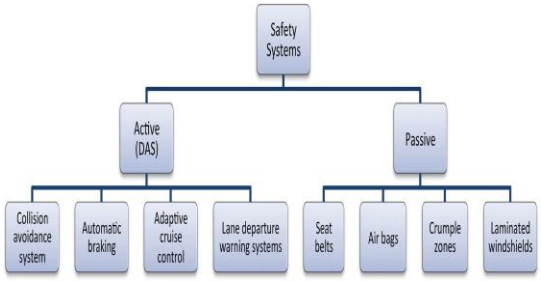

Figure 1: vehicle safety system and their types.

Since human behaviour is the main cause for occurrence of accidents where rear end collisions are the most common form, it is critical to equip with safety systems in vehicles as shown in Figure. 1. The safety systems can be either active or passive. The latter such as seatbelts, airbags and crumple zones have been widely employed for many years and it has almost reached its full potential in reducing the number of casualties. The former also known as on-board automotive driver alert system or driver assistance systems including collision avoidance systems, brake assistance and lane departure warning systems takes proactive steps to prevent an accident before it happens.

Collision Avoidance System

Collision avoidance is a major issue for active safety in the automotive industry. In employing systems such as adaptive cruise control, lane change control and overtaking control, a collision avoidance system is needed. Collision Avoidance System are rapidly making their way into the new vehicle fleet and major automobile manufacturers have made numerous predictions for the development of Collision Avoidance System technology in the near future.

II. LITERATURE SURVEY

1. L. Eckstein proposes a methodology to assess the impact of positioning and prediction accuracy on the potential benefit of collision avoidance systems. The predicted position of vulnerable road users (VRU) ahead of the vehicle is affected by measurement and prediction uncertainty. In advanced cooperative collision avoidance systems, the position of VRUs is provided by vehicle-to-vehicle or vehicle-to-infrastructure (V2X) communication. This work describes a method to optimise the vehicles longitudinal and lateral trajectories in critical situations in order to minimize the risk of the situation considering the influence of positioning and prediction inaccuracies of VRU. A method to approximate combined braking and evading trajectories is proposed and applied to analyse the impact of positioning and prediction inaccuracies of VRU on the risk.

2.Cheng - Yi Yu, Lung-Tsai Lee proposes the Vehicle-Mounted Detection and Collision Avoidance System based on Dedicated Short Range Communications by using dedicated short range communications (DSRC) technology, a technology that can make for packet transmission, GPS latitude and longitude values were obtained to analyse the scope of road warning, driving lane information obtained using 3G or Wi-Fi network to upload Cloud server for analysis. Internet of things combine big data extends for many applications, including intelligent cities, smart home, intelligent transportation or wearable devices. Internet of things combine big data extends for many applications, including intelligent cities, smart home, intelligent transportation or wearable devices. There is little analysis for individual vehicle or group of the vehicle. Design a monitoring system to collect the vehicle, road conditions, traffic information, driver information, traffic planning and realization of the information points to master.

3.Samriddhi Sarkar proposes a multi-agent based modelling of intersection collision avoidance technique for the trains, passing through the intersection. Petrinets (PN), a mathematical tool, is used here to model the claimed system keeping in mind the concurrent and dynamic nature of the railway system. To verify properties such as reachability, liveness, boundedness of the proposed system, reachability tree, invariants, state equation are used. According to this model after a successful communication between train agents and controller agent, trains cross the intersection safely. Unlike the existing system there is no need of human intervention. All the agents will collectively execute goal i.e, to pass through the intersection without any conflict.

4. Rajesh Rajamani focuses on the development of a collision avoidance system for bicycles for prediction and prevention of rear and side crashes at intersections. Cost, size and weight constraints highly limit the sensors and electronics that can be used on a bicycle and necessitate the development of new vehicle detection and tracking systems. Custom sonar and laser sensors and associated position estimation algorithms for tracking are developed. A custom sonar sensor with one sonar transmitter and two receivers is developed to estimate both the distance and angular orientation of vehicles on the sides of the bicycle. A custom single-target laser sensor on a rotating platform is developed to track longer distance vehicles. A model predictive control formulation is used to determine the real-time orientation of the rotating laser platform. Preliminary experimental data is presented to evaluate the performance of the side sonar system from a prototype instrumented bicycle.

III. DESIGN METHODOLOGY

The microcontroller used is ATMEGA 2560. Diverse peripherals are connected with microcontroller using IO line and correspondence port. LCD is connected with microcontroller to display information like, frequency and speed. Radar sensor used is HB 100which is a modernized, doppler sensor. The signal obtained from the radar sensor will be in low PRFs. Hence there is a need to convert the signal from milli volts to micro volts which is done using filtering circuit. The amplified signal is passedto the microcontroller for steering operations. Microcontroller process the data and showcases it on LCD. The block diagram is as shown in figure 2:

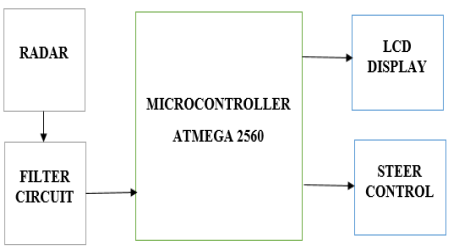

Figure 2: Block diagram

Microwave motion sensor of HB series works in X-band which is designed for movement detection. It consists of Dielectric Resonator Oscillator (DRO), microwave mixer and patch antenna. It operates at +5V DC for continuous wave operation.

ATmega2560 is an 8-bit CMOS low-power microcontroller; it is mainly works on Advanced Virtual RISC(AVR) enhanced RISC architecture. 1MIPS(Million instruction per second) throughput can be accomplishes per 1MHZ by executing a set of instruction per 1-cycle permitting the system engineer to enhance the processing speed verses power consumption.

A 20x4 LCD display is a fundamental module and is usually utilized as a part of different gadgets and circuits. Here it is used to display frequency and proximity warning. A 20x4 LCD implies it can show 20 characters for every line and there are 4 such lines. Figure 3.6 shows physical appearance of LCD.

Servo motor is a simple DC motor operated for specific angular rotation by using additional servo mechanism i.e., error sensing feedback. In servo mechanism, there will be three basic components- a controlled device, output sensor and a feedback system.

IV. TEST RESULTS

The waveforms obtained from the filter circuit is shown in fig3 and fig4

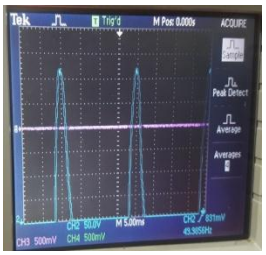

Figure 3: Boosted gain from first to last stage of the output from BPF.

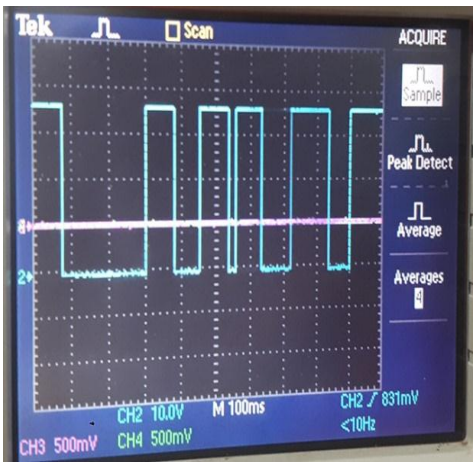

Figure 4: Output waveform from detected metal object

LCD used to display the frequency of the radar is shown in fig5.

Figure 5: Display of frequency and speed

V. CONCLUSIONS

Increased in road accidents due to pedestrians, blind spot vehicles or dark spot vehicles, poor visibility, crossing animals is happening now a day and it is gradually increasing day by day. Because of this both the sides will suffer. Conventional available proximity devices have its own limitations by sensing range or sensing speed. For this reason, UWB Doppler radar based system is designed.

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REFERENCES

[1] Ching-Fu Lin, Jyh-Ching Juang, Kun-Rui Li Member of IEEE"Active collision avoidance system for steering control of autonomous vehicles".

[2] Qichen Wang, Chris Phillips University of London, UK "Cooperative Collision Avoidance for Multi-Vehicle Systems Using Reinforcement Learning" in 2013.

[3] Linda Corucci, Adriano Meta, Alex CocciaMetaSensing BV, "An X-band Radar-Based Airborne Collision Avoidance System Proof of Concept", Huygensstraat, 44, 2201 DK, Noordwijk, The Netherlands in 2013.

[4] Loay Ismail, LubnaEliyan, RazanYounes, and Reem Ahmed," Monocular Vision-Based Collision Avoidance System using Shadow Detection" 2013 IEEE GCC Conference.

[5] Liang Li, Guangquan Lu, Yunpeng Wang, Daxin Tian, "A Rear-end Collision Avoidance System of Connected Vehicles",2014 IEEE 17th International Conference on Intelligent Transportation Systems (ITSC) October 8-11, 2014. Qingdao, China.

[6] P. Themann, J. Kotte, D. Raudszus and L. Eckstein, "Impact of Positioning Uncertainty of Vulnerable Road Users on Risk Minimization in Collision Avoidance Systems",2015 IEEE Intelligent Vehicles Symposium (IV) June 28 - July 1, 2015. COEX, Seoul, Korea.

[7] Yi - Ying Chang, Cheng - Yi Yu, Lung-Tsai Lee, "Research of Vehicle-Mounted Detection and Collision Avoidance System based on Dedicated Short Range Communications", 2016 IEEE.

[8] Samriddhi Sarkar and Animesh Dutta,"Petri Net Based Modelling of Railway Intersection Collision Avoidance System", 978-1-5090-1555-9/16/$31.00 ©2016 IEEE.

[9] Woongsun Jeon and Rajesh Rajamani, "A Novel Collision Avoidance System for Bicycles," in 2016 American Control Conference (ACC) Boston Marriott Copley Place July 6-8, 2016. Boston, MA, USA

[10] Amir Mukhtar, Likun Xia, *Member*, *IEEE*, and Tong Boon Tang, *Member*, *IEEE*"Vehicle Detection Techniques for Collision Avoidance Systems"C. Pererа*et al*.," Context Aware Computing for The Internet of Things: A Survey," ieee communications surveys & tutorials, vol. 16, no. 1, first quarter 2014, pp 414 – 417.