

Vehicle Crash Avoidance Using Adaptive Neural-Fuzzy Inference System

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Abstract - Vehicle crashes are considered to be events that are extremely complex to be analyzed from the mathematical point of view. In order to establish a mathematical model of a vehicle crash, one needs to consider various areas of research. For this reason, we simply analyze and improve the modeling process. In this project, a novel adaptive neural fuzzy inference system (ANFIS based) approach is implemented to reconstruct kinematics for colliding vehicles. A typical five-layered ANFIS structure is trained to reproduce kinematics (acceleration, velocity and displacement) of a vehicle involved in an oblique barrier collision. Subsequently, the same ANFIS structure is applied to simulate different types of collisions than the one which was used in the training stage. Finally, the simulation outcomes are compared with the results obtained by applying different modeling techniques. The reliability of the proposed method is evaluated.

Index Terms - MEMS, Gyroscope, ANFIS, UART, ADC, SMAC protocol, Ultrasonic Sensor.

I. INTRODUCTION

The automotive industry pays exceptional attention to vehicle crashworthiness. Road safety organizations or rating programs like e.g. Euro NCAP or national highway safety traffic administration are responsible for executing vehicle crash tests and verifying whether cars satisfy the safety requirements and conform to safety standard. Due to this complexity and cost of the full-scale crash tests, it is advisable to predict and assess the overall car performance without a need to conduct a numerous full-scale experiments. This is being done ultimately to improve the safety of vehicle occupants [1], since according to the side impacts are still a serious automotive problem. The measurement contains random errors and consequently, the vehicle and object state estimates that are obtained in the sensor fusion layer are associated with uncertainties. A threat assessment algorithm utilizes these estimates to make predictions of road-user trajectories. Based on these predictions, an assessment is performed to estimate if and how a potential accident can be prevented. Both the state estimates and the predictions are associated with uncertainties that need to be treated properly. Moreover to obtain a high customer acceptance, it is important that the system also accounts for the performances of driver, such that the driver is not disturbed by the system during normal driving conditions.

Gyroscopes and MEMS are the most appropriate devices for motion compensation in sports cars/bikes. A gyroscope is a device for measuring or maintaining based on the principles of conservation of angular momentum. Micro-Electro-Mechanical Systems, or MEMS, is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of micro-fabrication.

II. BLOCK DIAGRAM

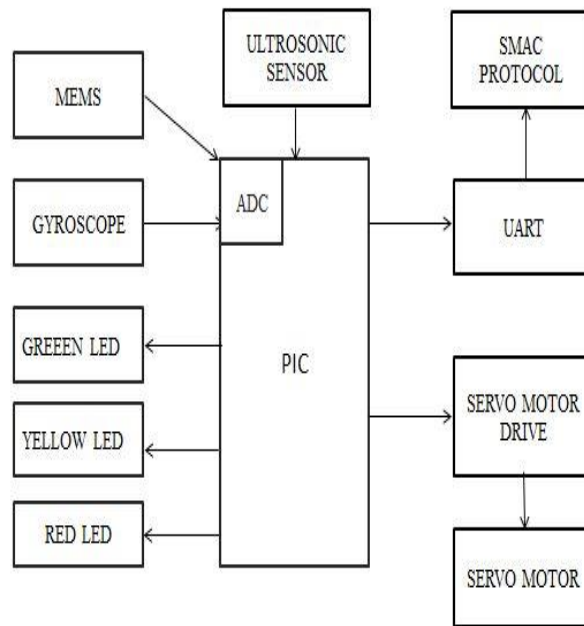


Fig.1 Transmitter section

PIC CONTROLLER-Features

High-Performance RISC CPU

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle.
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle.
- Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory.
- Pin out compatible to other 28-pin or 40/44-pin.
- PIC16CXXX and PIC16FXXX microcontrollers

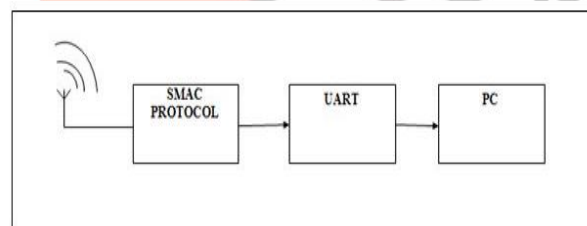


Fig.2 Receiver section

III. COMPONENTS DESCRIPTION

MEMS

Acceleration is a measure of how quickly speed changes. Just as a speedometer is a meter that measure speed, an accelerometer is a meter that measures acceleration. You can use an accelerometer's ability to sense acceleration to measure a variety of things that are very useful to electronic and robotic projects and designs. The advantage of MEMS allows these complex electromechanical systems to be manufactured using batch fabrication techniques, decreasing the cost and increasing the reliability of the sensors and actuators to equal those of integrated circuits.

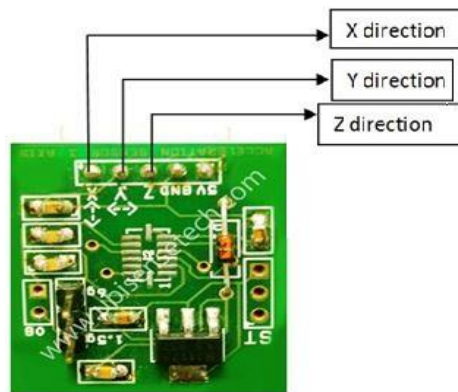


Fig.3 MEMS

GYROSCOPE

A gyroscope is a device for measuring or maintaining orientation, based on the principles of conservation of angular momentum.

ULTRASONIC SENSOR

Ultrasonic sensors work on the principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio sound waves respectively.

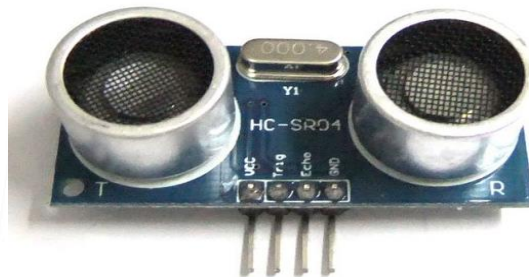


Fig.4 Ultrasonic sensor

UART

A universal asynchronous receiver/transmitter is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with other communication standards such as EIA RS-232.

SERVO MOTOR

A servomechanism, or servo, is an automatic device that uses error-sensing negative feedback to correct the performance of a mechanism.

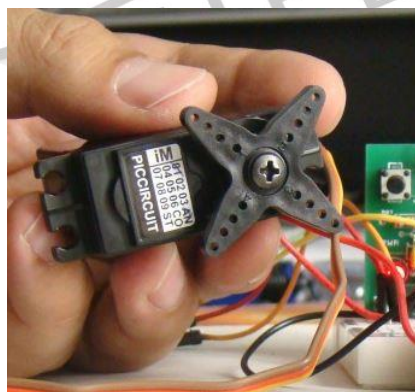


Fig.5 Servomotor

SMAC PROTOCOL

SMAC means sensor medium access control used for data communication protocol.

LED

A light-emitting diode (LED) is an electronic light source. All early devices emitted low-intensity red light, but modern LEDs are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

ADC

Analog-to-digital conversion is an electronic process in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal.

IV. WORKING

By using the ultrasonic sensor we can detect whether the vehicle is near or far. If the vehicle is so far away green led will blink or if the vehicle is somewhat far away yellow led will blink and if it is nearer then red led will blink so that we can control and avoid accidents.

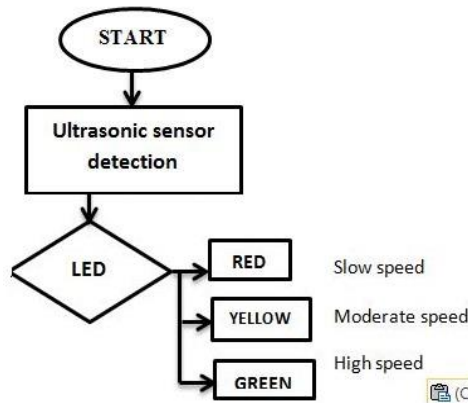


Fig.6 Ultrasonic sensor working

By using MEMS we can detect in which direction it is moving. If there is any problem during driving in any direction at that the powerful servo motor will balance the vehicle in order to avoid collision.

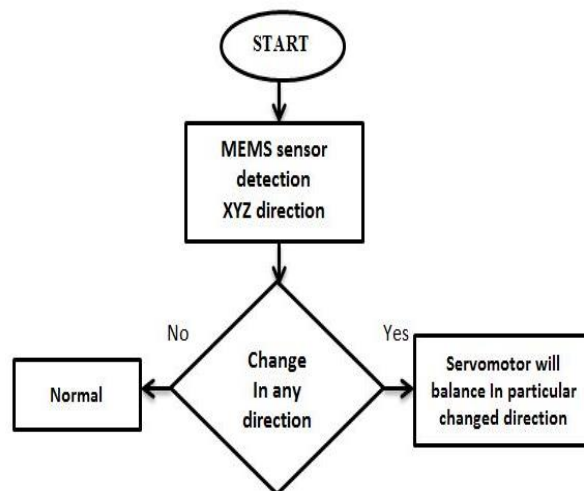


Fig.7 MEMS sensor working

In the same GYROSCOPE is used for measuring for angular momentum. If there is any sudden change in any axis of the wheel the servo meter will balance the vehicle in opposite direction of the wheel in order to avoid collision.

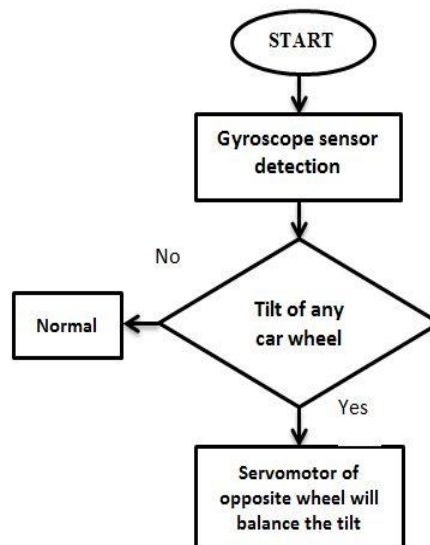


Fig.8 Gyroscope working

V. SOFTWARE

This guide is intended to introduce you to the HI-TECH C PRO for the PIC10/12/16 MCU Family compiler and its use in Microchip's MPLAB IDE. Code will be produced for the Microchip PICDEM 2 PLUS demo board, running a PIC16F877A MCU device. Programming will be performed via a Microchip MPLAB ICD 2 in-circuit debugger. Code will be written to flash the 4 LEDs on the board.

VI. RESULTS

My using Mp lab the following can be calculated pitch, roll, X, Y, Z can be plotted visually in PC as shown in the below figure. In Gyroscope we can see pitch and roll values. In MEMS we can see X-value, Y-value, Z-value respectively.

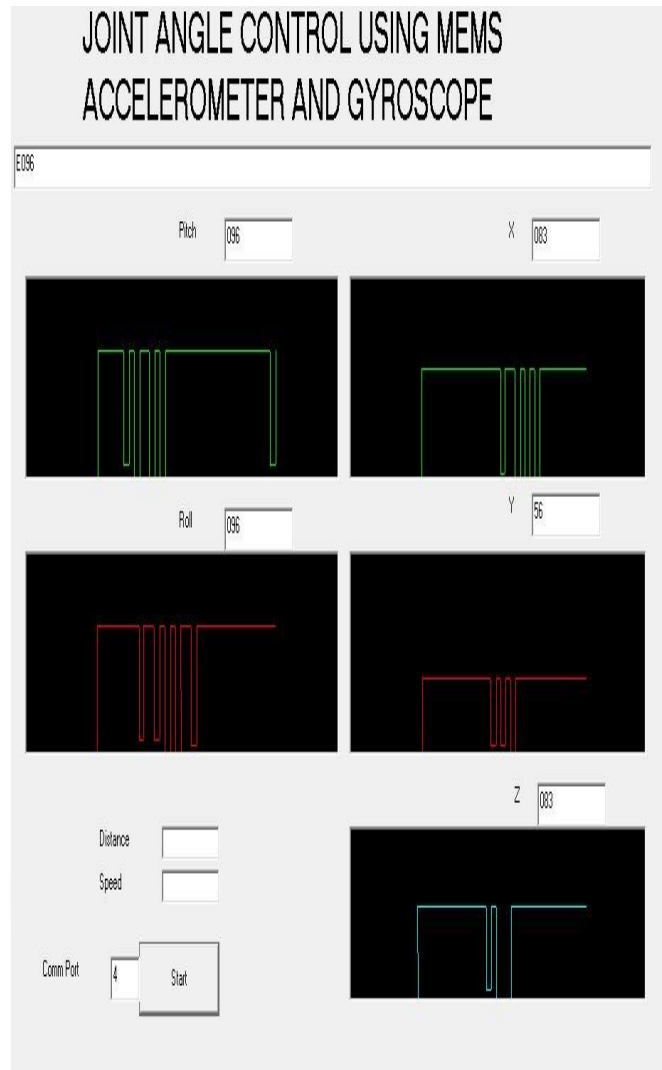


Fig.9 Results

VII. CONCLUSION

The hardware and software design of an embedded monitoring system for real time applications is presented in this paper. Motion of the colliding vehicles is monitored using the controller. The monitoring and controlling process is carried out by the controller. The whole process is implemented in hardware.

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