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Fuzzy logic based automatic braking system for automobiles

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ABSTRACT

Using fuzzy logic controller automatic braking system for automobiles is proposed. The response of the system will be simulated by using Fuzzy Logic Toolbox in MATLAB. The purpose of this controller is to brake a car when the car approaches for an obstacle at a specific range. For this, the Fuzzy Logic Controller is design using the Fuzzy Logic Toolbox in MATLAB. The system uses six rules and three membership function. The two parameters such as distance and speed will be observed. Output of the controller will determine the force of the car brake. Then PIC microcontroller is used to control servo motor based on detection pulse information to push pedal brake to brake the car and reduce the speed to maintain the safety distance between the front vehicles.

Introduction

All the greatest achievements of the history, automobiles are most probably the one which significantly changed human life. The periodical improvement in the technology gives human race a new height. In the later years after independence the number of vehicles subsequently increased but in the last two decades it spreads drastically in every level of the society hence safety becomes the main concern. Road Accidents account a severe threat to the lives in both ways physical as well as financial, even after digital control of the vehicle. However, due to human avoidance, circumstantial error and negligence accidents occur. Many people lost their life every year in vehicle collision majorly due to drivers' inability to keenly observe the vehicles' vicinity while driving and in traffic condition. Road facilities are a major concern in the developed world. Recent studies show that one third of the number of fatal or serious accidents are associated with excessive or inappropriate speed, as well as changes in the roadway (like the presence of road-work or unexpected obstacles). In Malaysia, major of the road facilities is cause by the populations, environment, behavior, attitudes and perceptions of risk in disadvantaged communities. Such as the user was charged with a speeding offence (normally exceeding the speed limit), drunk driving, driving with lack of sleep. By this the speed is an important issue in highway, construction zones, school zones, and general speed limit zones. Government had implemented many kind of road safety to the communities but any how it is difficult to enforce speed limit regulations since police cannot monitor every driver. Reports of road accident statistics do not always distinguish between these categories of speeding but it is expected that most reported cases involve excessive speed. In 2009, there were 397,330 road accidents recorded compared to 328,264 in 2005, an increase of 21 per cent. Out of the total, there was thousands of innocent life lost every year. Although it is the case that a high speed crash is much more likely to result in a fatality, there are many more crashes which occur at relatively low speeds and, as a consequence, the majority of fatalities occur at these low speeds.

In recent years, the number and variety of applications of fuzzy logic have increased significantly. The applications range from consumer products such as cameras, camcorders, washing machines, and microwave ovens to industrial process control, medical instrumentation, decision-support systems, and portfolio selection. To understand why use of fuzzy logic has grown, you must first understand what is meant by fuzzy logic.

Fuzzy logic has two different meanings. In a narrow sense, fuzzy logic is a logical system, which is an extension of multivalued logic. However, in a wider sense fuzzy logic (FL) is almost synonymous with the theory of fuzzy sets, a theory which relates to classes of objects with unsharp boundaries in which membership is a matter of degree. In this perspective, fuzzy logic in its narrow sense is a branch of FL. Even in its more narrow definition, fuzzy logic differs both in concept and substance from traditional multivalued logical systems.

Problem Statement

Design an electronic control system to help the society to prevent the driver from drive faster than speed permit. This system is designed using ultrasonic sensor to capture the vehicle to vehicle distance, microcontroller to monitor and trigger the braking speed control system and braking speed control system to reduce the exceed speed. This would ease the burden place on law enforcement officials and decrease the vehicle accidents by giving the drivers more time to avoid the accidents. Besides that, the system also provides the vehicle to vehicle safety distance.
Although it is the case that a high speed crash is much more likely to result in a fatality, there are many more crashes which occur at relatively low speeds and, as a consequence, the majority of fatalities occur at these low speeds.

Scope of the project

Generally, this project consists of two main parts which are hardware and software approach implementation.

In the hardware part, the PIC microcontroller acts as the core system that controls the overall operation. An electronic design focuses on designing the Printed Circuit Board (PCB) to integrate PIC16F877A with LCD 16x2 display module, ultrasonic ranging module, DC motor, servo motor, variable resistor, voltage regulator, led, buzzer and switches.

In the software part, the program was written with Microcode Studio using PicBasic Pro Compiler. The PicBasic

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Pro Compiler makes it easy to program PIC microcontrollers. The English like BASIC language is much easier to read and write. This software is used to write the code, compile and build the file to produce the .HEX files. The Fuzzy Logic Controller is simulated in matlab. The response of the simulation is implemented in the system.

Related work

Automatic braking technologies combine sensors and brake controls to help prevent high speed collisions. Some automatic braking systems can prevent collisions altogether, but most of them are designed to simply reduce the speed of a vehicle before it hits something. Since high speed crashes are more likely to be fatal than low speed collisions, automatic braking systems can save lives and reduce the amount of property damage that occurs during an accident. Some of these systems provide braking assistance to the driver, and others are actually capable of activating the brakes with no driver input.

Each car manufacturer has its own automatic braking system technology, but they all rely on some type of sensor input. Some of these systems use lasers, others use radar, and some even use video data. This sensor input is then used to determine if there are any objects present in the path of the vehicle. If an object is detected, the system can then determine if the speed of the vehicle is greater than the speed of the object in front of it. A significant speed differential may indicate that a collision is likely to occur, in which case the system is capable of automatically activating the brakes.

However, automatic brakes can save your life if you ever suffer from a momentary lapse in concentration. Automatic braking systems are primarily designed as a safeguard against distracted driving, and the technology can also save lives if a driver happens to fall asleep behind the wheel. Many drivers will never need to make use of this type of system, but it's still a nice safety net to have.

There are many causes of road accident but most of them are due to the human error. The main objective of intelligent car system is able to control to speed and distance between the cars. The intelligent car system can be takes the input from sensor, camera and satellite. Sensor knows the distance of the object from the car to move. The satellite helps the car system to decide the route which is better, faster and safer. The camera function is to decide the car movement by using a vision algorithm. The deployment of the intelligent car system will help to avoid the car accident and it will also help in avoiding traffic jams.

Fuzzy logic controller (flc)

Fuzzy logic was formulated by Lotfi Zadeh of the University of California at Berkeley in the mid-1960s, based on earlier work in the area of fuzzy set theory. Zadeh also formulated the notion of fuzzy control that allows a small set of 'intuitive rules' to be used in order to control the operation of electronic devices. In the 1980s fuzzy control became a huge industry in Japan and other countries where it was integrated into home appliances such as vacuum cleaners, microwave ovens and video cameras. Such appliances could adapt automatically to different conditions; for instance, a vacuum cleaner would apply more suction to an especially dirty area. One of the benefits of fuzzy control is that it can be easily implemented on a standard computer. Fuzzy controllers appear in consumer products such as washing machines, video cameras, cars. As for in industry, for controlling cement kilns, underground trains, and robots. A fuzzy controller is an automatic controller, a self-acting or self-regulating mechanism that controls an object in accordance with a desired behaviour. The object can be, for instance, a robot set to follow a certain path. A fuzzy controller acts or regulates by means of rules in a more or less natural language, based on the distinguishing feature: fuzzy logic. The rules are invented by plant operators or design engineers, and fuzzy control is thus a branch of intelligent control.

Methodology

Overview

This project design use to help the society to prevent the driver from drive faster than speed permit. Braking speed control system, ultra-sonic sensor are important parts for this project and the microcontroller became the main brain to manage the step function, this chapter is to subscribe or summarize the developments of the project and put them in a larger technological context. By start with a general overview of the hardware design and analysis of project from which the approach advocated by this project has emerged and then we move to the more specific goal of the project, namely the exportation and adaptation of this approach to a wide class of systems where quantitative timing information plays a major role.

Braking Speed Control System

Braking speed control system was built as the demo of the vehicle car braking system. DC motor will be act as vehicle wheel and servo motor act as brake disc. The main purpose to use the servo motor (brake disc) to reduce the DC motor (vehicle wheel) turning speed (vehicle speed). The servo motor is controlled by the pulse width. The pulse width given to the servo motor in order control the movement is generated through Fuzzy Logic Cntroller (FLC). It is simulated in matlab and the response is implemented in the system.

Distance Control System

Speed control system and distance control system are combined and form a new system. Both systems were interface with the PIC microcontroller to control speed and distance in the vehicle. Both systems also can active in the same time as well. Either one of the systems received the alert signal; braking speed control system will be active and reduce the vehicle speed to safety speed and distance. Whereby the inputs is taken from the ultrasonic sensor and rpm sensor given to the FLC. The simulated response of the controller is implemented in the microcontroller. Thus the microcontroller able controls both system simultaneously and also display the distance of obstacle and speed of the motor in the LCD display. Whenever the vehicle reaches the predetermined critical distance it will alert the user by trigger buzzer and also give signal to the servo motor to apply the brake and stops the vehicle immediately.

Project Flow

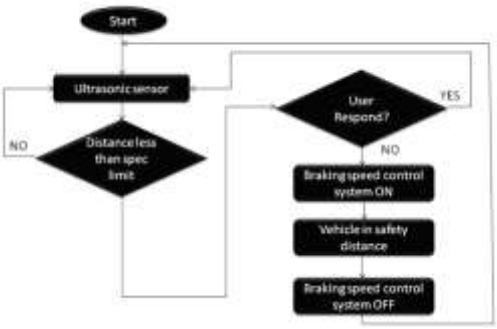
The flow of this project begins by making literature review on various internet articles, journal and thesis relevant to this project. After gaining enough information, the Fuzzy Logic algorithm is generated, simulink model of the system is designed in the matlab, circuit design for LCD module, ultrasonic sensor, braking speed control system and PIC 16F877A is carried out. This is done with the software Microcode Studio using PIC Basic Pro. Next is the circuit construction and assembly of all the components on a PCB followed by making the software to operate the LCD module, braking speed control system using PIC Kit2 programmer.

Fuzzy Logic Controller Design

Fuzzy logic toolbox from MATLAB is used to develop a controller for fuzzy logic. Using the Fuzzy Inference System Editor (FIS), the editor involve is FIS editor, membership function editor and rule editor. Meanwhile, rule viewer and

surface viewer are used to display the output of the controller designed.

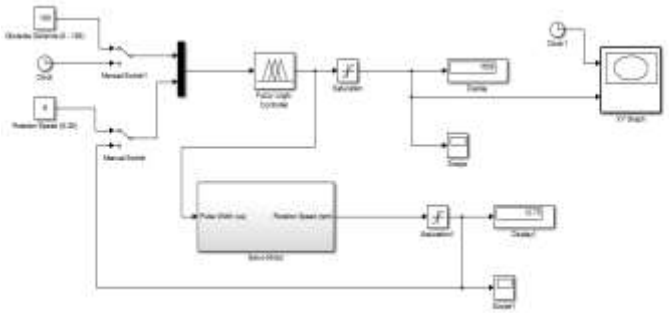
Process Flow



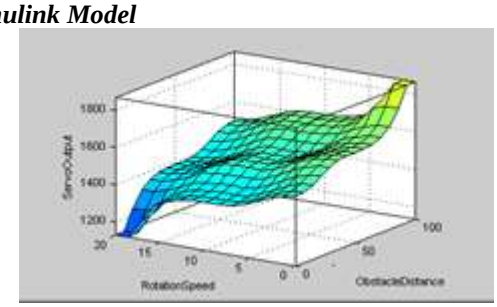
Flow Chart

Fuzzy Logic Simulink Design

Based on Y=MX + C, the simulink model of fuzzy logic controller is done, the rotational speed of dc motor is denoted as Y, while the pulse width of servo motor is denoted as X. The initial pulse width is 1000us. Maximum speed of the motor is 20rpm. From the calculation, we get M = 20/1000 and C = -(20000/1000). Its output can be diverges, with or without oscillation, and is limited only by saturation or mechanical breakage. Tuning a control loop is the adjustment of its control parameters to the optimum values for the desired control response.



FIS Simulink Model



Surface Viewer

Using the fuzzy logic toolbox, the first things to be done is at the FIS Editor. The FIS Editor handles the high-level issues for the system. It displays general information about a fuzzy inference system. For the car brake controller design, there are two inputs and one output that are design through the toolbox. The inputs are obstacle distance and rotation speed. The output is the servo output.

The obstacle distance represents the distance of the car from the obstacle detected. Rotation speed is measured from the velocity of the car towards the obstacle and servo output represents the force of the car brake needed to stop the car. Defuzzication method used for this controller is mean of maximum (mom) method.

Conclusion

As a conclusion, all objectives in the project have been achieved as proposed. Despite facing many problems in duration of this project, all problems faced have been resolved. Therefore, the system can be work together with 3 major parts, speed control system, distance control system and braking speed control system. This project had successfully enhanced ultrasonic sensor to captured the vehicle to vehicle distance and braking speed control system is used to reduce the exceed speed. All the hardware modules and software are integrated and tested successfully. Hopefully with this vehicle speed and distance control system will able to help the society to prevent the driver from drive faster than speed permit and decrease the vehicle accidents by giving the drivers more time to avoid the accidents and saved more life.

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