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Nonlinear Coordinated Steering and Braking Control of Vision-Based Autonomous Vehicles in Emergency Obstacle Avoidance

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Abstract:

The main aim of the project is to dynamic control design for automated driving of vision-based autonomous vehicles, with a particular focus on the coordinated steering and braking control in emergency obstacle avoidance. An autonomous vehicle uses a complex multi-input and multi-output structure, which possesses the features of parameter uncertainties and strong nonlinearities, and the fixed phenomena of lateral and longitudinal dynamics are clear in a combined cornering and braking movement. The effective coordinated control system for automated driving is wished-for to deal with these coupled and nonlinear features and eliminate the disturbances. First, a vision algorithm is constructed to detect the orientation path and offer the local location information between vehicles and reference path in real time. Then, a novel coordinated steering and braking control approach is proposed based on the nonlinear back stepping control theory and the adaptive fuzzy sliding-mode control method. Finally, experimental tests evident that the proposed control strategy possesses encouraging tracking performance and enhances the riding comfort and constancy of autonomous vehicles.

Keywords: *LPC2148, ultrasonic sensor, usb camera.*

Introduction:

The main aim of the project is to dynamic control design for automated driving of vision-based autonomous vehicles, with a focus on the coordinated steering and braking control in emergency obstacle avoidance.

Autonomous vehicles apply information, sense and control techniques to enhance driving safety and efficiency, which are regarded as one of the effective ways to improve traffic safety and reduce fuel consumption. Due to these potential benefits, researches on autonomous vehicles have attracted more and more attentions. Automatic driving control system is a crucial component of autonomous vehicles in ITS, which mainly includes lateral and longitudinal motion control. The

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fundamental mission of lateral and longitudinal control is to automatically and accurately track the desired trajectory at the set speed while ensuring the safety, stability and riding comfort of autonomous vehicles.

An enormous deal of practice and research on the lateral motion control has been done in recent years. A nested PID steering control architecture with two independent control loops in vision-based autonomous vehicles is proposed and it can reject the disturbances on the curvature which increase linearly with respect to time. In order to simulate human decision making and analogical reasoning, an intelligent fuzzy steering control strategy is given.

Firstly, a vision algorithm is constructed to detect the reference path and provide the local location information in real-time. Then, an adaptive nonlinear coordinated control strategy is proposed to overcome the strong nonlinearities and parametric uncertainties.

HARDWARE SYSTEM

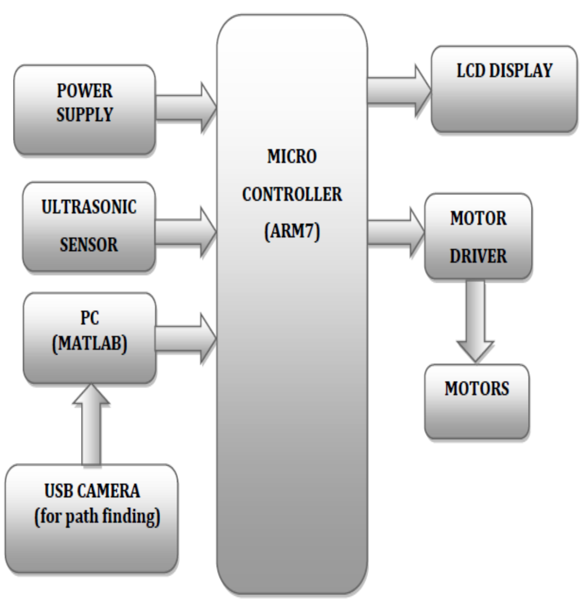

Fig 1: Block Diagram

METHODOLOGY

Micro controller:

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI:

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**):

is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

Ultrasonic sensor:

The sensor is primarily intended to be used in security systems for detection of moving objects, but can be effectively involved in intelligent children's toys, automatic door opening devices, and sports training and contact-less-speed measurement equipment. Infrared sensors are characterized by high sensitivity, low cost and are widely used. But, these sensors can generate false alarm signals if heating systems are active or temperature change speed exceeds some threshold level. Moreover, infrared sensors appreciably lose sensitivity if small insects penetrate the sensor lens. Ultrasound motion

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detection sensors are characterized by small power consumption, suitable cost and high sensitivity. That it why this kind of sensor is commonly used in home, office and car security systems. Existing ultrasound sensors consist of multiple passive and active components and are relatively complicated for production and testing. Sensors often times require a laborious tuning process.

Fig.2: Ultrasonic sensor

PC Monitor:

The HDMI-VGA cable is attached updated raspberry-pi and the LJ R interface of the cable is attached updated. The face of the character getting captured can be visible on up-to-date. The Raspberry Pi has a HDMI port which you can plug without delay into a display or tv with an HDMI.

WEBCAM

"Webcam" refers to the technology generally; the first part of the term ("web-") is often replaced with a word describing what can be viewed with the camera, such as a netcam or streetcam. Webcams are video capturing devices connected to computers or computer networks, often using USB or, if they connect to networks, Ethernet or Wi-Fi. They are well-known for low manufacturing costs and flexible applications. Video capture is the process of converting an analog video signal—such as that produced by a video camera or DVD player—to digital form. The resulting digital data are referred to as a digital video stream, or more often, simply video stream. This is in contrast with screen casting, in which previously digitized video is captured while displayed on a digital monitor

Webcams typically include a lens, an image sensor, and some support electronics. Various lenses are available, the most common being a plastic lens that can be screwed in and out to set the camera's focus. Fixed focus lenses, which have no provision for adjustment, are also available. Image sensors can be CMOS or CCD, the former being dominant for low-cost cameras, but CCD cameras do not necessarily outperform CMOS-based cameras in the low cost price range. Consumer webcams are usually VGA resolution with a frame rate of 30 frames per second. Higher resolutions, in mega pixels, are available and higher frame rates are starting to appear.

Fig.3: Webcam

The video capture process involves several processing steps. First the analog video signal is digitized by an analog-to-digital converter to produce a raw, digital data stream. In the case of composite video, the luminance and chrominance are then separated. Next, the chrominance is demodulated to produce color difference video data. At this point, the data may be modified so as to adjust brightness, contrast, saturation and hue. Finally, the data is transformed by a color space converter to generate data in conformance with any of several color space standards, such as RGB and YCbCr. Together, these steps constituted video decoding, because they "decode" an analog video format such as NTSC or PAL. Support electronics are present to read the image from the sensor and transmit it to the host computer. The camera pictured to the right, for example, uses a So nix SN9C101 to transmit its image over USB. Some cameras - such as mobile phone cameras - use a CMOS sensor with supporting electronics.

FEATURES:

- Smallest wireless video & audio camera
- Wireless transmission and reception
- High sensitivity
- Easy installation & operation
- Easy to conceal
- Light weight
- Low power consumption
- Small size

SPECIFICATIONS:

- Output frequency: 900MHZ 1200MHZ
- Output power: 50mW 200mW
- Power supply: DC +6~12v
- Distance covered: 10m

DC Motor:

Fig.4: DC Motor

A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnetic field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°.

Motor driver (L293D):

DC motors are typically controlled by using a transistor configuration called an "H-bridge". This consists of a minimum of four mechanical or solid-state switches, such as two NPN and two PNP transistors. One NPN and one PNP transistor are activated at a time. Both NPN and PNP transistors can be activated to cause a short across the motor terminals, which can be useful for slowing down the motor from the back EMF it creates. H-bridge. Sometimes called a "full bridge" the H-bridge is so named because it has four switching elements at the "corners" of the H and the motor forms the cross bar. The switches are turned on in pairs, either high left and lower right, or lower left and high right, but never both switches on the same "side" of the bridge. If both switches on one side of a bridge are turned on it creates a short circuit between the battery plus and battery minus terminals. If the bridge is sufficiently powerful it will absorb that load and your batteries will simply drain quickly. Usually however the switches in question melt.

RESULT

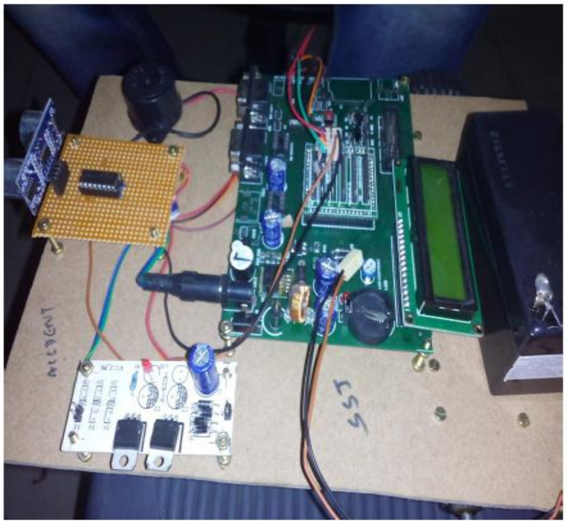

Fig.5:Hardware kit

Fig.6:Road ways

CONCLUSION

The results indicate that GNSS is suitable for railway localization, but the performance of GNSS in different railway environmental scenarios varies a lot. The overall reliability and availability are evaluated as the basis for safety analysis. In open area, GNSS is shown as a good instance for stand-alone localization and fits the railway RAMS requirements quite well. However, in the forest, the GNSS performance cannot meet the requirements; other onboard localization sensors, together with GNSS receiver to provide sensor fusion structure, are required.

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