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Driver Behavior Model with Stability in the Presence of Driver Uncertainty using Embedded Design

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Abstract: A cybernetic driver model for vehicle lateral control that takes into account what is known about sensor motor and cognitive control in humans has recently been proposed. The model was identified and validated using experiments with human drivers on SCANeR, which is a fixed base driving simulator. Here, we briefly present the essential information on the driver model in the perspective of designing the shared control law. The developed model is based on the hypothesis that drivers use visual information to identify the approaching road curvature and the position of the vehicle in relation to the edge lines. Drivers have been shown to use "near" and "far" vision of the roadway for steering, which is represented in a model by the angles between the car heading and two distinct points. The near point is used to maintain a central lane position; it is assumed to be at a convenient distance from the front of the vehicle. It is near enough to monitor lateral position but faraway enough to be seen through the vehicle windshield (look ahead distance is, fixed here at 5 m).We can overcome the disadvantage of the existing method by improving system prototype is built on the base of one embedded platform ARM7 which controls all the processes. Experimental results illuminate the validity of the driver's behavior.

Keywords: LQFP (Least Quad Flat Package), IRS (Iris Recognition System).

Introduction

There are many reasons why in the present days electronic driving aids are designed and developed at an increasing rate and speed. The most and foremost reason was to improve safety and avoid accidents at the time of driving. Driving is a dangerous activity which will have a serious impact on human and economic principles. Primarily a „human factors" case is safety. But in most of the cases accidents occur due to driver inattention. According to surveys 90% of accidents occur because of driver failure at the time driving. The main cause of this failure is degradation in driver performance due to some factors such as fatigue, drowsiness or inattention. There are also some other reasons for the driver degradation in them the first reason is alcohol, when the driver was in drunk condition then it is a difficult activity to drive at this state there is chance of occurring accidents and one more reason for occurring accidents is if driver suddenly felt unhealthy that means like sudden heart attacks or some other severe health problems then it was difficult to control vehicle during driving which ultimately causes accidents [1-3].

The control or reduction of vehicle accidents requires counter measures that has to be designed and introduced to avoid those behaviors' contributing to accidents. So in order overcome all these problems there are a need of one system which helps the driver to improve the safety at the time of driving. These factors have motivated to a major research effort in electronic driving aids and these research and development had a strong impact on driver comfort ability which is aimed at helping human and improving the safety, particularly by an active system that have a potential to avoid accidents. Many driver assistance systems have been proposed over the last decade to improve vehicle control and human safety. In those some of them are based on the principle of mutual control between the driver and on automation system. But there is a problem while in designing such a kind of human-machine interaction system because manual control vehicle tasks [4] are prone to driver error, and fully machine controlled tasks are subjected to wide –ranging of limitations.

Literature Survey

Jose I. Hernandez and Chen-Yuan Kuo, in 2003 proposed a **Steering Control of Automated Vehicles Using Absolute Positioning GPS and Magnetic Markers (**IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 52, NO. 1, JANUARY 2003**)** Steering control for passenger cars on automated highways is analyzed. Feasibility of an automatic steering system based on absolute positioning global positioning system (GPS) and a magnetic marker guidance system has been evaluated using computer simulations. State estimation and control algorithm issues are examined for such control system. By use of GPS and a magnetic marker sensor, an accurate and real-time estimation of the vehicle's lateral displacements with respect to the road can be accomplished. A steering control algorithm based on road curvature preview for achieving good road tracking and providing ride comfort is also presented.

Jóse E. Naranjo, Carlos González, Ricardo García, Teresa de Pedro, and Rodolfo E. Haber, in 2005 proposed a **Power-Steering Control Architecture for Automatic Driving (**IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 6, NO. 4, DECEMBER 2005**)** The unmanned control of the steering wheel is, at present, one of the most important challenges facing researchers in autonomous vehicles within the field of intelligent transportation systems (ITSs). In this paper, we present a two-layer control architecture for automatically moving the steering wheel of a mass-produced vehicle. The first layer is designed to calculate the target position of the steering wheel at any time and is based on fuzzy logic. The second is a classic control layer that moves the steering bar by means of an actuator to achieve the position targeted by the first layer. Real-time kinematic differential global positioning system (RTK-DGPS) equipment is the main sensor input for positioning. It is accurate to about 1 cm and can finely locate the vehicle trajectory. The developed systems are installed on Citroën Berlingo van, which is used as a tested vehicle. Once this control architecture has been implemented, installed, and tuned, the resulting steering maneuvering is very similar to human driving, and the trajectory errors from the reference route are reduced to a minimum. The experimental results show that the combination of GPS and artificial-intelligence-based techniques behaves outstandingly. We can also draw other important conclusions regarding the design of a control system derived from human driving experience, providing an alternative mathematical formalism for computation, human reasoning, and integration of qualitative and quantitative information.

Proposed Architecture

In this proposed system, IRS (Iris recognition System) is used to detect the iris of the driver and compare it with the predefined iris. For example, in the night when the car's owner is sleeping then IRS obtains images by one tiny web camera which can be hidden in the car. IRS compares the obtained image with the predefined images if the image doesn't match, then the information is sent to the owner through SMS and speed of the vehicle gradually decreases and tail indications also given to alert back vehicles and also checks the alcohol content in the vehicle. If the alcohol is high then automatically gives the alarm and also sends the message to the owner with location and speed gradually decreases. And also monitoring the steering whether the driver is pick the steering or not with the help of reflection sensors. If the driver is not pick the steering then automatically gives the Alarm [4] [5].

When we switch on the power, the web camera starts capturing videos of road environment and fed to the pc. The pc will process the video with the help of MATLAB and image processing tools. Here the image processing tools divide the video into frames and they convert them into gray level images and apply the edge detection technique. With this it provide the information about line dispatch and curvature which fed to microcontroller as an input. Now the microcontroller process the input from pc about road curvature and lane dispatch then control the steering according to the instructions given in the form of program. Here when the processor receives a command like left dispatch, it will alerts the driver first by giving a buzzer / alarm and then control the

steering for right direction and at the same time if microcontroller receives a command like right dispatch it will controls the steer for left direction and if microcontroller receives a curve dispatch it will controls the steer according to the angel of deviation.

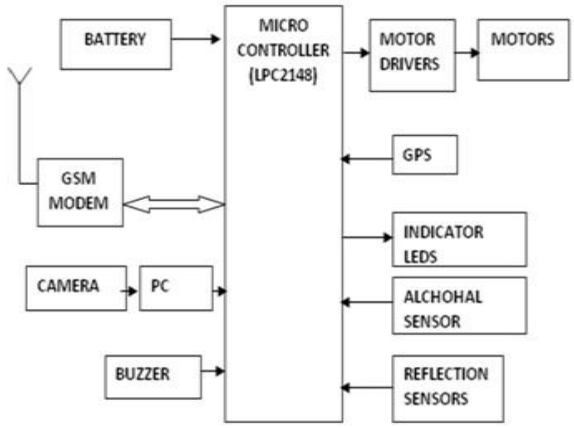

Figure.1. System Block Diagram

Figure.2. Receiving System.

Many advanced assistance systems have been developed over the last decade to improve vehicle lateral control. Some of them (man-machine systems) developed based on the principle of mutual control between driver and automation system. In man-machine systems, the mechanical response of the Control interface (e.g., knob, mouse, joystick, steering wheel) to the action of a human is not typically considered as a feedback signal to the human operator. Rather, a visual or auditory sensory input closes the loop in the traditional manual control analyses. In many cases, the response from the control interface does not carry information pertinent to the execution of manual control.

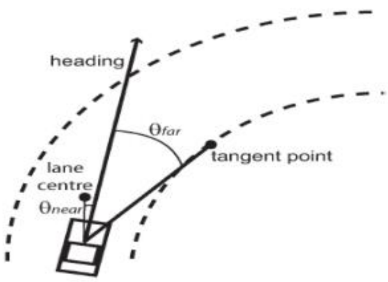

Figure.2.1 Road pattern

At the same time microcontroller scans the ultrasonic sensor, here the ultrasonic sensor is used to find the obstacles which are present opposite to the vehicle. Ultrasonic sensors when in active state, it will generate a high frequency waves and evaluate the echo"s which are received back by the sensor, by measuring the time interval between sending signal and receiving the echo the sensor will determine the distance between vehicle an object. And thus if any such information coming from the sensor it will controls the DC motor which will represents the ignition of the vehicle [5] [6] [9] The system also continuously display the status by using LCD.

It has multiple serial interfaces including two UARTs (Universal Asynchronous Receiver Transmitter) those are UART0, UART1 and two Fast I2C-bus(Inter Integrated Circuit) and also consists of SPI(Serial Peripheral Interface) and SSP(Synchronous Serial Port) these are the synchronous serial protocols with buffering and variable data length capabilities. It has on chip PLL with settling time of 100µs and also has on-chip integrated oscillator operates with an external crystal in range from 1 MHz to 30 MHz and this external oscillator frequency will be extended up to 50 MHz.LPC2148 have Power saving modes include Idle and Power-down. And it also has Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC). LPC2148 is operated with the voltage range of 3.0 V to 3.6 V (3.3 V ±10 %) with 5 V tolerant I/O pads.

LCD

LCD is used to display the information about the current process. Liquid crystal displays (LCDs) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in anordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarizer are pasted outside the two glass panels. These polarizes would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizes and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent. When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizes, which would result in activating/ highlighting the desired characters. The LCD‟s are lightweight with only a few millimeters thickness. Since the LCD‟s consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

GSM Modem

The GSM modem will communicate with microcontroller using serial communication. The modem is interfaced to microcontroller using MAX 232, a serial driver. Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service. The standard is used in approx. 85 countries in the world including such locations as Europe, Japan and Australia. GSM (Global System for Mobile communication)is a digital mobile telephone system that is widely used in many parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM operates in the 900MHz, 1800MHz, or 1900 MHz frequency bands.GSM has been the backbone of the phenomenal success in mobile telecoms over the last decade. Now, at the dawn of the era of true broadband services, GSM continues to evolve to meet new demands. One of GSM's great strengths is its international roaming capability, giving consumers a seamless service.

A GSM modem can be an external modem device, such as the Wave com FASTRACK Modem. Insert a GSM SIM card into this modem, and connect the modem to an available serial port on your computer. A GSM modem can be a PC Card installed in a notebook computer, such as the Nokia Card Phone. A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port on your computer. .A dedicated GSM modem (external or PC Card) is usually preferable to a GSM mobile phone. This is because of some compatibility issues that can exist with mobile phones. For example, if you wish to be able to receive inbound MMS messages with your gateway, and you are using a mobile phone as your modem, you must utilize a mobile phone that does not support WAP push or MMS. This is because the mobile phone automatically processes these messages, without forwarding them via the modem interface. Similarly some mobile phones will not allow you to correctly receive SMS text messages longer than 160 bytes (known as “concatenated SMS” or “long SMS”). This is because these long messages are actually sent as separate SMS messages, and the phone attempts to reassemble the message before forwarding via the modem interface [9] [10].

PC Section

This section basically contains a PC with Serial communication associated hardware. Apart from this, the web cam is also connected to the PC. The serial communication associated hardware circuitry includes the bus (DB 9) connector from PC to Microcontroller.

GPS Modem

A GPS modem is used to get the signals and receive the signals from the satellites. In this project, GPS modem get the signals from the satellites and those are given to the microcontroller. The signals may be in the form of the coordinates; these are represented in form of the latitudes, longitudes and altitudes.

Motors

Motor is an output device; its speed will be varied according to the speed set by the switches. The speed can be varied by varying the voltage given to the PWM converter (using keypad). The speed of DC motor is directly proportional to armature voltage and inversely proportional to flux. By maintaining the flux constant, the speed can be varied by varying the armature voltage.

Buzzer Section

This section consists of a Buzzer. The buzzer is used to alert / indicate the completion of process. It is sometimes used to indicate the start of the embedded system by alerting during start-up.

Results

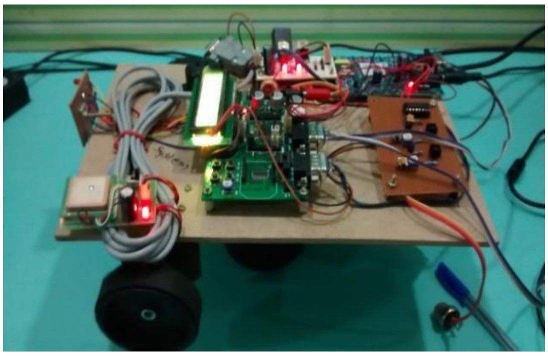

Fig.3. Side view of the hardware.

The above figure shows the model developed as which will be fit in to the vehicle to provide assistance to driver. This model is best suitable for electric cars; with some modifications this can be applicable to the cars which contain engines. In the above figure there is a wheel to indicate the steering action and there is one more wheel to indicate the vehicle speed under the control and the driver. The screen shot is work under test of the driver assistance system.

Fig.4. Output of no hand detected on steering.

If any object is found on the lane, then the corresponding signal is given to the controller and based on that, the position of the steering gets adjusted. If the vehicle detects the obstacle in the right side border of the lane then the vehicle become automatically slow and taking the left side of the lane

Fig.5. Right hand detected on steering.

Fig.6. Left hand detected on steering**.**

Finally it is tested around 20 times it worked very accurately in 18 times hence this system provides 90% accuracy in result.

Fig.7. Output of alcohol detection.

Conclusion

The implementation of ARM7 based driver behavior and vehicle tracking system is done successfully. The communication is properly done without any interference between different modules in the design. Design is done to meet all the specifications and requirements. Software tools like Keil µvision Simulator, Proload to dump the source code into the microcontroller, Orcad lite for the schematic diagram have been used to develop the software code before realizing the hardware.

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