ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

Automobile Locomotary Disaster Mitigation Mechanism Incorporating a Novel Realtime Counter Commanding – A Comprehensive Approach

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ABSTRACT: In this paper proposes an Adaptive Cruise Control (ACC) based electronic system which employs on-road counter active measures during the moments of distress. Real time control is unleashed by restraining the vital variables in the automotive and also a flawless and constant monitoring of the chauffer's health and psychometric parameters using Real time operating system (RTOS). This design involves the GPS embarked ACC which uses an extremely swift digital electronic speed control in several ambience of hazardous and restricted nature. This system holds the potential to become a standard accessory across the class of vehicles in the burgeoning automobile industry where safety has become indispensable

KEYWORDS: Sonar, ACC, ARM Cortex-M3, FreeRTOS, GPS

I.INTRODUCTION

In sustaining the automobiles commanded speed, the adaptive cruise control superimposes the role of conventional cruise control. But, the characteristic absence of observing appropriate clearance between the adjoining vehicles along the same path in conventional cruise control is addressed using adaptive cruise control. Sensing element embarked on the front hood of the locomotive is used to trace the onward slow paced automobiles. With the noting of inferior paced vehicles upfront, ACC is engaged to sustain adequate clearance between the fellow leading vehicles in its path by getting rid of the speed. With the absence of onward vehicles in front, the ACC will throttle the vehicle back to the set speed. Such indigenous real time speed control measures were undertaken by the vehicle mounted with ACC after meticulously contemplating the vital physical and mental parameters of the chauffer. Proposed ACC system is attached with a GPS device to zero in on special areas of speed restriction within the pre-programmed vicinity limits of the vehicle.

When the locomotive fitted with ACC comes within the speed restricted zone, the system decelerates itself below the desired commanded speed adhering to the pre-set safety standards and on leaving the restricted zone the system regains the pre-set commanded speed in the absence of locomotives moving less than the set speed upfront.Systems fitted with ACC will undertake several precautionary safety actions by consistently measuring the chauffer's heart rate and also a digital MEMS compass is used to monitor the concentration level of the driver. During moments of distress the system will itself come to the idle state.ACC can be engaged by using a switch or by mechanically actuating the accelerator or brake lever in a specific pattern. For designing this intricate real time system FreeRTOS, an open source is adopted.

II. COMPONENT MODULE DIAGRAM

Module diagram of the ACC system with digital Memes campus,GPS module ,Graphical LCD for display,Matrixkeypad,Accelerator and braking system with pedal sensor,rotary encoder ,DC motor ,Heart rate sensor as shown in the fig 1

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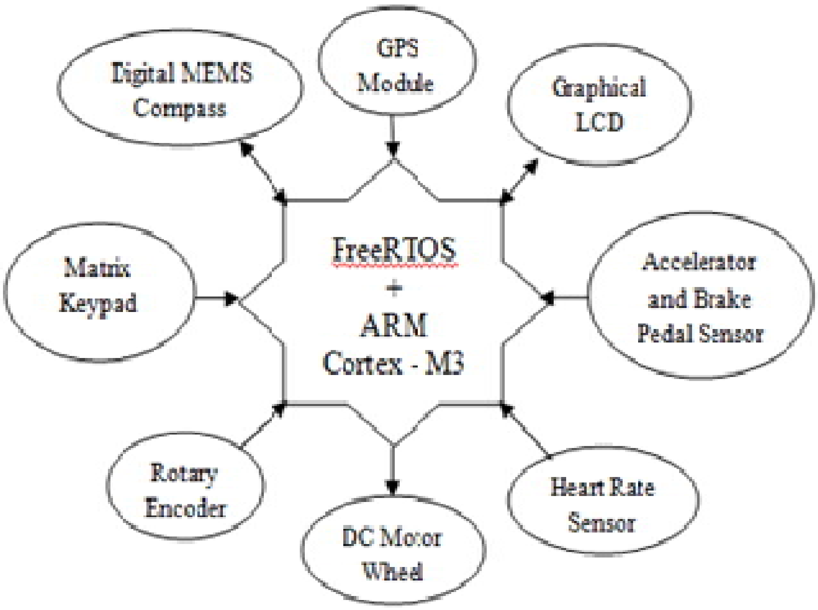

.Fig.1 Module diagram of ACC system.

III.NECESSITY OF RTOS

The versatility of the most widely and currently used electronic processors is restricted to momentarily undertake the processing of singular command, with swiftly altering among various singular commands a multitasking operating system can be made to pretend as if each task is processed parallel. The use of a multitasking operating system can simplify the design of what would otherwise be a complex software application. The multitasking and inter-task communications features of the operating system allow the complex application to be partitioned into a set of smaller and more manageable tasks. It allows inter-task communication. The partitioning can result in easier software testing, work breakdown within teams, and code reuse. Complex timing and sequencing details can be removed from the application code and become the responsibility of the operating system.

IV.RTOS IMPLEMENTED

FreeRTOS is a popular real-time operating system for embedded devices, being ported to 31 microcontrollers, including ARM Cortex-M3 used in our prototype. FreeRTOS is designed to be small and simple. The kernel itself consists of only three or four C files. To make the code readable, easy to port, and maintainable, it is written mostly in C, but there are a few assembly functions included where needed (mostly in architecture specific scheduler routines).
Free RTOS provides methods for multiple threads or tasks, murexes, semaphores and software timers. A tick-less mode is provided for low power applications. Thread priorities are supported. FreeRTOS implements multiple threads by having the host program call a thread tick method at regular short intervals. The thread tick method switches tasks depending on priority and a round-robin scheduling scheme. The usual interval is 1/1000 of a second to 1/100 of a second, via. an interrupt from a hardware timer, but this interval is often changed to suit a particular application.

Key features of FreeRTOS are,

- Very small memory footprint, low overhead, and very fast execution.
- Tick-less option for low power applications.
- Equally good for hobbyists who are new to OS, and professional developers working on commercial products.
- Scheduler can be configured for both pre-emptive and cooperative operation

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V.HARDWARE COMPONENTS

Microcontroller: 32-bit ARM Cortex-M3 microcontroller acts as the brain of the system.
GPS: 66-channel GPS module sends the location data as NMEA packets, interfaced to the microcontroller using UART
Display: monochrome Graphics LCD Display acting as the dashboard display for the driver to operate the system.
Heart Rate Sensor: used to sense driver heart beats, output is digital pulses, finger mounted.
Head Tilt Sensor: digital MEMS Compass sensor measures the head tilt angles.
SONAR: ultrasonic distance sensor (dual) sense the front vehicle gap.
Throttle-Brake Sensor:analog output brake pedal and throttle pedal sensing.
DC Motor: wheel is attached with this motor.
Rotary Encoder: used to sense the speed of the motor, attached with the motor shaft.
Matrix Keypad: used to input the control parameters of the ACC system by the driver.

VI.SOFTWARE COMPONENTS

FreeRTOS: Open Source Real Time Kernel for Embedded Applications, makes the system responsive and deterministic.
Peripheral Drivers: used for thread safe UART, I2C and PWM peripheral handling.
Graphics Display Driver: used to handle Graphics LCD in a thread safe manner to display text and plot graph.
NMEA Protocol Decoder: used to parse the latitude and longitude position sent by the GPS module.

VII.OPERATION MODES

We will discuss modes of operations used in this prototype.

- Measuring distance of preceding vehicle.
- Using GPS to find the speed restricted zone.
- Monitoring driver status.

Measuring distance of preceding vehicle

Ultrasonic distance sensor (SONAR) present in the front of the ACC vehicle calculates the distance of the preceding vehicle. TRIGGER pin and ECHO pin of SONAR is connected to microcontroller. When short pulse is applied to TRIGGER pin, transmitter starts sending radio pulses and set ECHO pin from low to high. Radio pulses upon reflected back from preceding vehicle set ECHO pin from high to low state. Total transition time from ECHO is used to determine the distance of preceding vehicle.If the distance measured from SONAR is less compared to safe distance pre-set by the microcontroller the DC Motor stops. Otherwise, the operation is normal. This operation is performed only when ACC is switched ON using keypad.

Using GPS to find speed restricted zone

GPS modules Tx and Rx is connected to Rx and Tx of microcontroller. GPS receiver receives the coordinates of the current location in NMEA format. NMEA packets are transmitted to microcontroller using UART serial communication in TTL level. Baud rate for all communication protocol should be set to same value.Upon receiving the location information, the values are compared with look-up table of all restricted zone which is stored in memory of the microcontroller. If the ACC system reaches the restricted zone, DC motor is made to slow to minimum speed programmed in microcontroller.

Monitoring driver status

Heart rate sensor is used to monitor driver health status. Sensor values are ported into ADC (Analog Digital Convertor) pin and the digital value is compared with our look-up table value and in case of detection of abnormal value from

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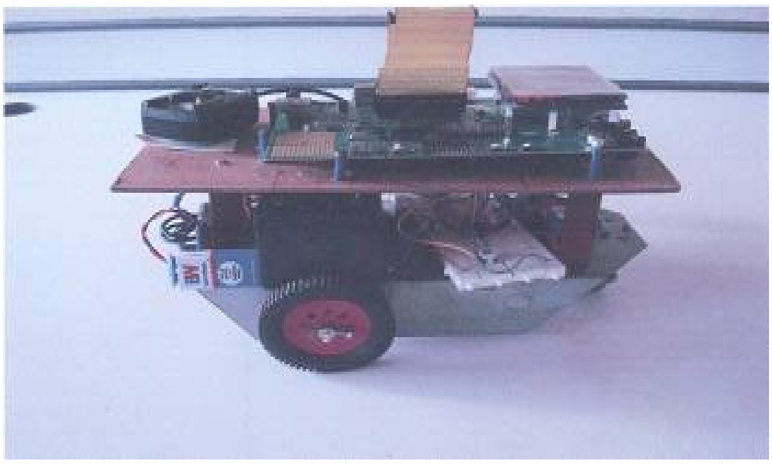
sensor the DC motor is made to stop. To monitor driver's distraction, digital MEMS compass is used. Communication is done using I2C protocol. Microcontroller acts as master and MEMS compass acts as slave.

VIII.HARDWARE IMPLEMENTATION

Designing a prototype can project the concept of adaptive Cruise Control. This prototype is capable of detecting vehicle moving in front and also monitors the status of the driver. The interfacing part must be done carefully to avoid impedance mismatching and logic level problems with the target board. The photography of the developed prototype model is shown Figure 2



.Fig 2. Side view of the prototype

IX.CONCLUSION

In this approach, a prototype is designed and implemented using FreeRTOS, a Real Time Operating System and programming is done using the Keil MDK-ARM. The LCD controller has been enabled successfully which gives the status message of the prototype like ACC engaged, Vehicle detected, GPS co-ordinates and drivers health status.

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