Driver Fatigue Detection System Using MEMS Technology

Vaishali B Dhabale[1]
[1]M.Tech. (Electronics & Communication) Student,
Vidarbha Institute of Technology. Nagpur(MS), INDIA
[1]vaishalidhable@gmail.com

Vinay Keshwani [2]
[2]Professor
Vidarbha Institute of Technology. Nagpur(MS), INDIA
[2] vinaykeswani2009@yahoo.com

ABSTRACT

This paper presents analysis of head pose (HP) for continuous monitoring of alertness of a train driver. Most existing approaches to visual detection of non-alert driving patterns rely either on body motion or head nodding angles to determine the driver drowsiness or distraction level. Drowsy driving has been implicated as a causal factor in many accidents. Therefore, real-time drowsiness monitoring can prevent traffic accidents effectively. However, current BCI systems are usually large and have to transmit an EEG signal to a back-end personal computer to process the EEG signal.[1] In this study, a novel BCI system was developed to monitor the human cognitive state and provide biofeedback to the driver when drowsy state occurs. The ever increasing numbers of traffic accidents all over the world are due to diminished driver's vigilance level. For this reason, developing system that actively monitors the driver's level of vigilance and alerting the driver of any insecure driving condition is essential for accident prevention. If the driver is drowsy then a message is sent to the authorized person that the driver is drowsy through wireless technology. In this with the help of MEMS we can be able to know the position of the driver in the train.

INTRODUCTION

In spite of the excellent safety record of railways as a means of transportation, there have been occasions when drivers have allowed their train to pass a point where they should have stopped. Many of these incidents have resulted in collisions, some involving loss of life and most involving damage to equipment or property. [2]Most incidents are the result of a driver failing to ensure that his train stops at a stop signal due to falling asleep or might be died etc. In India, this has become known as SPAD or Signal Passed at Danger. Such incidents have occurred on railways ever since they began in the early 19th century and various systems have been introduced to try to prevent them. These have taken the form of both warning and train stop systems. In India, a warning system is used for providing the awaking mode for Loco Pilot. An alarm sounds in the driver's cab whenever a train approaches a caution or stop signal. If the driver fails to acknowledge the alarm, the train brakes are applied automatically. The system is called AWS (Automatic Warning System). Taking in action all these things, we are supposed to develop a machine for detecting the real time status of the loco pilot which will capture the fatigue, motion and heartbeat rate of the loco pilot providing alertness to the driver. This technology will always make the alert system to the driver for detecting the various signals coming in front of the railway.

OVERVIEW

The main aim the paper is "To check alertness of train driver with an analysis of head pose & to prevent accidents". This paper presents analysis of head pose (HP) for continuous monitoring of alertness of a train driver. The proposed scheme uses features such as HP to extract critical information on non-alertness of a train driver. This paper presents analysis of head pose (HP) using a Micro Electro Mechanical System for continuous monitoring of alertness of a train driver. [4]The proposed scheme finds in real time HP angles by using MEMS & IR Sensor. The proposed method brings HP together to make a decision if a driver is not alert.
Driver inattention might be the result of a lack of alertness when driving due to driver drowsiness and distraction.

LITERATURE REVIEW

Driver fatigue ('falling asleep at the wheel') is a cause of train accidents, accounting for up to 20% of serious accidents on railways sector. It identifies driver fatigue as one of the main areas of driver behavior that needs to be addressed if the target for reducing the number of people killed and seriously injured in train accidents by 30% by 2012 is to be achieved. Hence for reducing this accident rate, we are supposed to design and developed a model for providing driver alert system during fatigue detection by the machine and providing the real time status of the driver to the remote located sub stations.

MEMS (micro electro-mechanical systems) technology has gone from an interesting academic exercise to an integral part of many common products. [6]But as with most new technologies, the practical implementation of MEMS technology has taken a while to happen. The design challenges involved in designing a successful MEMS product (the ADXL2O2E) are described in this article by Harvey Weinberg from Analog Devices.

In early MEMS systems a multi-chip approach with the sensing element (MEMS structure) on one chip, and the signal conditioning electronics on another chip was used.

Of course, history teaches us that integration is the most cost effective and high performance solution. So Analog Devices pursued an integrated approach to MEMS where the sensor and signal conditioning electronics are on one chip.

HARDWARE COMPONENTS

Microcontroller (AVR ATMEGA 16)

- Micro Electro Mechanical System (MEMS device)
- Zigbee Technology
- Buzzer
- Power supply
- LCD Display
- Motion Sensor

Transmitter section

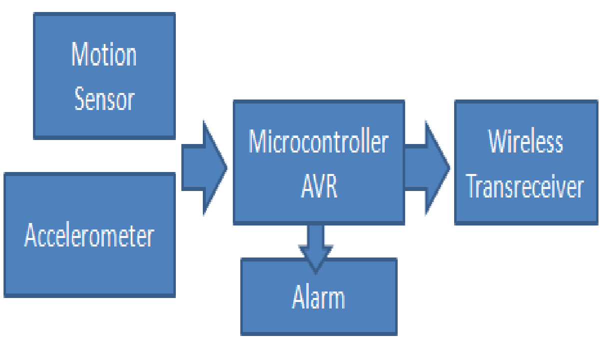

Fig 1: Block Diagram

Receiver Section

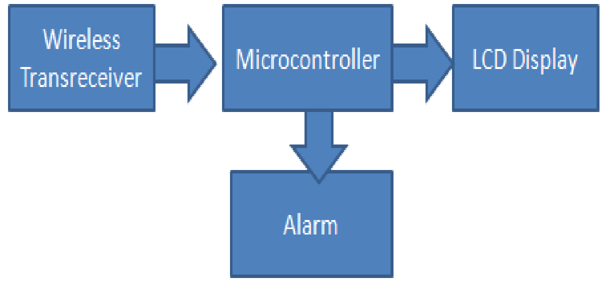

Fig 2: Block Diagram

MICROCONTROLLER (AVR ATMEGA 16)

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

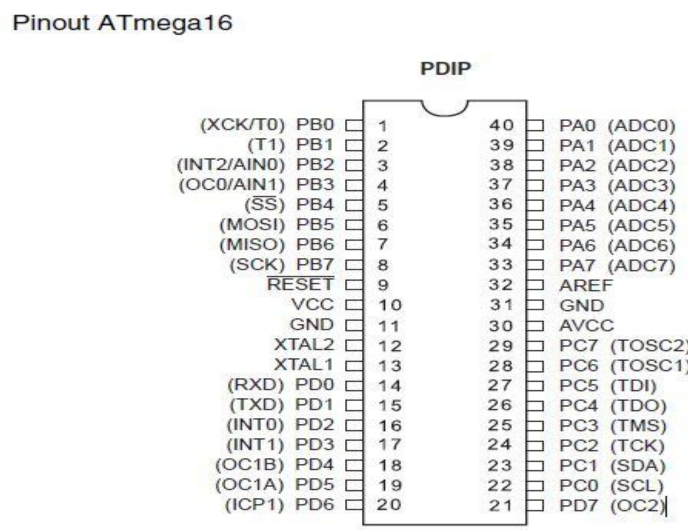

Fig 3: Pin Configuration ATmega 16

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega16 provides the following features: 16K bytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 512 bytes EEPROM, 1K byte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary-scan, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential

input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the USART, Two-wire interface, A/D Converter, SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run.
The device is manufactured using Atmel’s high density nonvolatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any Interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega16 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications. The ATmega16 AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in-circuit emulators, and evaluation kits.

MICRO ELECTRO MECHANICAL SYSTEM MEMS

The MMA7660FC is a ±1.5 g 3-Axis Accelerometer with Digital Output (I2C). It is a very low power, low profile capacitive MEMS sensor featuring a low pass filter, compensation for 0g offset and gain errors, and conversion to 6-bit digital values at a user configurable samples per second. The device can be used for sensor data changes, product orientation, and gesture detection through an interrupt pin (INT). The device is housed in a small 3mm x 3mm x 0.9mm DFN package.

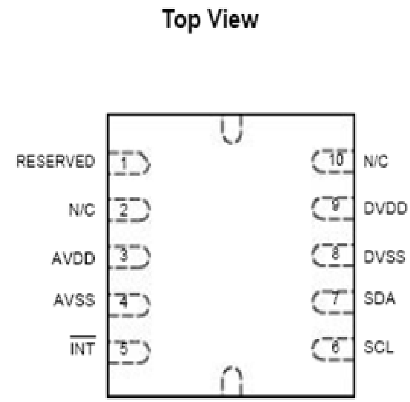

Fig.4 MEMS PIN Configuration

Fig.5 MEMS Bottom View

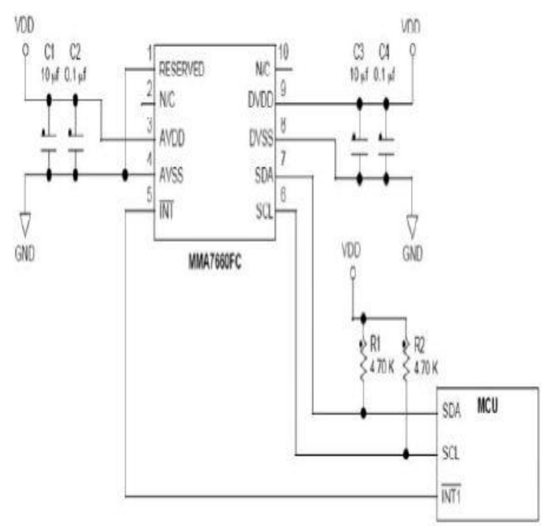

Fig.6 MEMS Device

PIN DESCRIPTION

Pin #	Pin Name	Description	Pin Status
1	RESERVED	Connect to AVSS	Input
2	N/C	No Internal Connection, leave unconnected or connect to Ground	Input
3	AVDD	Device Power	Input
4	AVSS	Device Ground	Input
5	INT	Interrupt/Data Ready	Output
6	SCL	I^2C Serial Clock	Input
7	SDA	I^2C Serial Data	Open Drain
8	DVSS	Digital I/O Ground	Input
9	DVDD	Digital I/O Power	Input
10	N/C	No Internal Connection, recommended to connect to Ground	Input

Table.1.Pin description

DESIGNING

The main intension of the paper is to design and implement a Driver alertness detection by using Head Pose. This will detects the alertness of driver based on head pose i.e., whether he is in drowsy or sleepy condition. In order to fulfill this design there are few steps that has been performed …

The steps are as follows:
1) Designing of the power supply for the entire circuitry.
2) Selection of microcontroller that suits our application.
3) Selection of Micro Electro Mechanical Systems (MEMS Device).
4) Selection of motion Sensor.
5) Selection of Zigbee Module
6) Selection of LCD Display.
7) Selection of Buzzer.

Complete studies of all the above are useful in developing this. In-order to work with any components basic requirement is power supply. In this section there is a requirement of two different voltage levels, those are 12V DC and 5v DC. The Driver Drowsiness Detection System consists of Cortex M3 LPC 1768 Microcontroller, Micro electro mechanical system MEMS, Zigbee Technology, LCD Display. First initialize all the components by giving proper power supply to all the devices. After giving power supply first MEMS device has been initialized and then Motion sensor initialized. By using EMBEDDED programming we have programmed the predefine angle in the MEMS device i.e. 45 degrees. if the person in the train nods or shakes his head and if the angle of his head exceeds more than the predefine angle the buzzer activates and simultaneously registered user gets an SMS that the driver in the train has been non-alerting stage along with a particular location because we have kept wireless technology to get location of the train. [7]
It is clear from the above block diagram that the MEMS Sensor will detect the real time status of the driver for fatigue detection and generating alarm as per the condition. There will be two types of sensors will be attached with the system containing accelerometer, Motion-PIR Sensor, which will be used for real time status of the driver. If something gone wrong then microcontroller will directly send the status message of the driver and their respective station master of the current station using wireless technology.

The Embedded C programming language and the Keil software have been used to program the microcontroller. So by this we can control the accidents occurring in our daily life by alerting driver. To avoid accidents this has been proposed.

RESULTS

In this Module there are components like MEMS device & Zigbee Technology will gets initiated after gets initiated MEMS device will checks the HEAD POSE i.e., at what angle person will nodding or shaking his head, PIR motion sensor less than normal rate if any error occurs in these then immediately alarm i.e. buzzer has been activated. So along with these the location of the train also been detected by using Zigbee module & the location of the train has been send to station who has registered earlier by using Zigbee Technology.

CONCLUSION

This paper has presented analysis of body motion state and HP & Micro Electro Mechanical Systems for continuous monitoring of alertness of a train driver.

FUTURE SCOPE

We are sure at last we can come over the solution with perfect status detection system for the driver of the train decreasing the accident level happens due to less alert by the loco pilot.
In future we can use the GPS system for detecting the real time position of the train with containing the video footage of the driver situation, sending via GPRS system to their respective locations.

REFERENCES

[1] Rakamal, "Embedded systems architecture, programming and design", Tata McGraw- Hill Education.
[2] http://www.nxp.com/documents/data_sheet.
[3] http://www.alldatasheet.com.
[4]IEEE PAPER on Driver Fatigue Detection System By: E. Rogado, J.L. García, R. Barea, L.M. Bergasa, *Member IEEE and E. Lopez* International Conference on Robotics and Biometrics in Bangkok, Thailand, February 21 - 26, 2009
[5]IEEE PAPER on Reconfigurable Computing in Next-Generation Automotive Networks by: Shanker Shreejith, Suhaib A. Fahmy, and Martin Lukasiewycz IEEE

EMBEDDED SYSTEMS LETTERS, VOL. 5, NO. 1, MARCH 2013
[6]INTERNATIONAL JOURNAL (IJEAT) paper on Vision-based Real-time Driver Fatigue Detection System for Efficient Vehicle Control by D.Jayanthi, M. Bommy ISSN: 2249 – 8958, Volume-2, Issue-1, October 2012
[7]Book: EMBEDDED SYSTEM DESIGN OF JPEG IMAGE DECOMPRESSION by: Parikshit Nigam B.E., Sardar Patel University, India, 2006