Final Design Report

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Project Title:  SLEEP

Team Name:  No Rest for the Weary

Team Members:

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Team: No Rest for the Weary

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Abstract
We have decided to make a system that help will drivers stay alert while driving on the road. We will use a monitoring system based on eyelid movement that will work in unison with a microcontroller to check against certain voltage parameters that will determine if the driver is considered asleep. Research was done to find appropriate methods to determine whether an individual was falling asleep at the wheel.

Introduction
The National Highway Traffic Safety Administration of the United States estimates that on average each year approximately 100,000 vehicular accidents are caused by sleepy (dozing or falling asleep at the wheel) drivers. Drowsy driving kills yearly about 1,500 (drivers and passengers) and causes 71,000 bodily injuries. For example, if a drowsy driver is driving at 65 mph and nods off for just three (3) seconds, the driver will have traveled the length of a football field, if the driver does not hit something first.

Highway accidents are very prevalent and our design would be help to this problem by monitoring the eyelid movement of the driver. Our project can have major effects on the car industry and the way drivers travel from place to place. Using a sensor to compare an open eye to a closed eye for a prolonged period will be the basis of our project.

Project Features / Objectives
This system will be used to keep drivers alert while driving on the road and will reduce the amount accidents caused sleepy drivers.

The main features will include:
- 3 LED state designators
- QRB 1114 as the eyelid movement sensor
- Vibrator and speaker for alarms
- Powered by cigarette adapter 12V

Performance Objectives
We expect our project to be able to detect when the driver’s eyes are closed for a prolonged period of time and sound the alarm and vibrator that are part of the different alert states. This will result in awaking a driver that may have fallen asleep while driving. Since there is a possibility of false alarms, we are aiming to keep false alarms below 5%. Our project operates from a powered cigarette adapter of 12V.

The Competition
Our project has an active market for people who travel long distances at a time. This system could be beneficial to a range of users from truckers that travel daily to a family that travels a long distance twice a year. Our system will be different than current available ones because it will monitor eyelid movement instead of head motion. Instead of solely using a speaker to alarm the driver we will use a combination of a vibrator and speaker to alert a driver who has fallen asleep.
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Figure 1. This system monitors the driver's head movement and uses a speaker attached to the driver ear as the alerting system.

Technical Concepts
Our team started with a few ideas of practical ways to implement this project. There was research done on using heart rate/vitals as a method to detect a sleeping driver. We decide this would be beneficial as a secondary monitoring system because the heart rate can fluctuate depending on other factors such as emotions. Another method we researched was head movement with the use of mercury switches; this method is already similar to one that is currently on the market. Our last method of interest and the most technologically challenging is monitoring eyelid movement. With the help of Dr. Schwartz we were able to further explore the possibility of using eye recognition techniques.

We discussed implementation with Tanmay Rajpathak's eye recognition software into our project, adapting it to tell whether the eye is open or closed for the alerting. This was our original idea, but communication with Tanmay was lost. This caused us to revise our design to something our group could handle without the help of a third party.

With the help of Dr. Schwartz once again we found that there were photodiode sensors on the market that could be used in our project to detect eyelid movement. The QRB1114 has been implemented as the sole sensor used in our design. It is located under the eye of the driver and can detect changes in voltage from an open eye to a closed eye.

Since there is a possibility of false alarms, we are aiming to keep false alarms below 5%. We have three states to show the condition of the driver. Green LED will depict an alert driver; a yellow LED represents a driver falling into the “danger zone” and red LED will demonstrate a driver that has fallen asleep.
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The system operates on a 12V supply of a cigarette lighter, since they are found in all vehicles. The 12Vin is sent through a voltage regulator that outputs 5Vout to the rest of the circuit board. The microprocessor we are using is the ATMEGA32 due to price and ADC capabilities. The ADC is necessary to compare the voltage change from the eyelid movement.

Some key challenges we faced were coding. Finding the right time delay for the sensor to activate the alarms is important. If the delay is too short then the sensor will trip because of eye blinks. If the delay is too long a closed eye won’t trigger the system. Also finding the correct place and angle to mount the sensor in the goggles has a great impact on the functionality of the design.

**Project Architecture**

![Diagram](image-url)

Figure 3. Original design using Tanmay’s MATLAB code
Figure 4. Revised / Current design using QRB1114

Figure 4. Software outline. Time delays are subject to change.
The eye sensor detects the change in voltage and when it reaches a certain threshold it will trigger the alert system. The system isn’t only reliant on the voltage change but the length of the time the voltage drop is sustained. This is important because this will prevent against eye blinks triggering the system.

### Division of Labor

<table>
<thead>
<tr>
<th>Renard Sumlar</th>
<th>Tasks</th>
<th>Brad Bromlow</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>Preliminary Research</td>
<td>50%</td>
</tr>
<tr>
<td>50%</td>
<td>Presentations / Meetings</td>
<td>50%</td>
</tr>
<tr>
<td>60%</td>
<td>Documentation</td>
<td>40%</td>
</tr>
<tr>
<td>40%</td>
<td>Breakout Board Design</td>
<td>60%</td>
</tr>
<tr>
<td>100%</td>
<td>PCB Circuit Design</td>
<td>0%</td>
</tr>
<tr>
<td>0%</td>
<td>Programming / Coding</td>
<td>100%</td>
</tr>
<tr>
<td>40%</td>
<td>Testing / Debugging</td>
<td>60%</td>
</tr>
<tr>
<td>50%</td>
<td>Final Demo</td>
<td>50%</td>
</tr>
</tbody>
</table>

Table 1. Member responsibilities.

### Timeline (Gantt Chart)

Figure 5. Gantt Chart. Team progression throughout the semester.
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Bill of Materials

<table>
<thead>
<tr>
<th>Product</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>QRB1114 Sensors</td>
<td>$4.49</td>
</tr>
<tr>
<td>Vibrator/Shocker</td>
<td>$10.00</td>
</tr>
<tr>
<td>Piezo Speaker</td>
<td>$0.00</td>
</tr>
<tr>
<td>ATMEL Processor</td>
<td>$8.00</td>
</tr>
<tr>
<td>AC Cigarette Adapter</td>
<td>$14.00</td>
</tr>
<tr>
<td>LEDs</td>
<td>$2.00</td>
</tr>
<tr>
<td>Goggles</td>
<td>$12.00</td>
</tr>
<tr>
<td>Various R, C and other components</td>
<td>$0.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$50.49</strong></td>
</tr>
</tbody>
</table>

Table 2. Breakdown of cost of project.

* After the revision from our previous design the total cost of the project dramatically decreased.

References

Figure 6. Schematic from breadboard design
Figure 7. Multisim design
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Figure 8. Ultiboard design based on the Multisim layout
#include <mega32.h>
#include <delay.h>

#define GREEN PORTB.0        // Output port designations
#define YELLOW PORTB.1
#define RED    PORTB.2
#define BUZZER    PORTB.3
#define MOTOR  PORTB.4

#define START    PINC.0        // Input pin designations
#define RESET  PINC.1

unsigned char buzzer_on;    // Declaration of variables
unsigned char adc_data = 0xff;

// ADC interrupt service routine
interrupt [ADC_INT] void adc_isr(void)
{
    // Read the 8 most significant bits
    // of the AD conversion result
    adc_data=ADCH;
    ADCSRA=0xDE;   //start new conversion
}

interrupt [TIM0_OVF ] void ISR_TIMER0 (void)
{
    TCNT0 = 241;  //init count
    if(buzzer_on!=0)     //if buzzer on star tbuzzer at 1khz frec
        BUZZER = ~BUZZER;
}

void main (void)
{
    int i;
    // Declaration of variables
    char reset,state;

    PORTA=0x00;
    // Clear all ports
    DDRA=0x00;
    // Clear all memory

    // Analog Comparator initialization
    // Analog Comparator: Off
    // Analog Comparator Input Capture by Timer/Counter 1: Off
    // Analog Comparator Output: Off
    ACSR=0x80;
    SFIOR=0x00;

    // ADC initialization
    // ADC Clock frequency: 125.000 kHz
    // ADC Voltage Reference: AVCC pin
    // Only the 8 most significant bits of
    // the AD conversion result are used
    ADMUX=0x60;
ADCSRA = 0xDE;

DDRB = 0x1F; // outpus// Sets ports to output
DDRC = 0x00; // inputs// Sets pin inputs

    /***init Timer0***/
    TCCR0 = 0x04;  // prescaler 256
    TCNT0 = 241;  // init count
    TIMSK |= 0x01; // unmask timer 0 overflow interrupt
    SREG |= 0x80;

PORTB = 0x00;
reset = 0;

    while(1)
    {
        YELLOW = RED = buzzer_on = MOTOR = 0;
        // Sets all to 0 (Green is go!)
        GREEN = 1;
        state = 0;

        do{
            while(adc_data > 230);  // wait eye to lose if not green led on
            delay_ms(110);        // test if is not a tab

            if(adc_data > 230)  // in eye still closed go to green
                state = 1;
            else
                state = 0;
        }while(state == 0);
        // Eye closes, interrupts green

        GREEN = 0;        // green led off
        YELLOW = buzzer_on = 1;  // buzzer on
        reset = 0;
        i=0;
        do{
            delay_us(999);
            if(!RESET)
            {
                while(!RESET); // wait reset
                reset = 1;    // indicate has been a reset
            }
            i++;
        }while(!reset && i < 100);
        // reset routine

        if(reset != 1 )  // if reset don't wait
        {
            YELLOW = 0;
            RED = MOTOR = 1;

            while(RESET);    // wait reset
            while(!RESET);
        }
    }