INEN-101 – INNOVATION AND ENTREPRENEURSHIP MINDSET

Final Project

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Professor Tewolde

Project Title: **D**river **A**wareness in **V**ehicular **E**nvironments (D.A.V.E)

Team members:

1. John Weiser

2. Robert Connolly

3. Ian Villaroman

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I. INTRODUCTION

D.A.V.E is a Driver Awareness in Vehicular Environments system used to assist in the prevention of accidents due to a lack of alertness by drivers. D.A.V.E is based around the neural input from a Mind Flex based system reading into an Arduino board. D.A.V.E assists the driver through means of visual, audio and tactile feedback whenever the alertness of the driver drops below a safe driving threshold in order to remind the driver to stay alert to the road ahead.

According to the National Sleep Foundation, in a 2005 poll, 60% of adult drivers responded that they drove while drowsy, and 1/3 have fallen asleep at the wheel. The intention of D.A.V.E. is to assist drivers who decide to risk driving while drowsy and help them cope with their fatigue while making their way to their destination.

Cars are easy to drive, but yet the thing that is in our everyday routine is becoming one of the nation's leading causes of death. Last year, a reported 1,550 deaths was a result of driver fatigue crashes. Over $12.5 billion in damage (How can we help make driving safer for not only the driver but for the driver's family?

Need

The consumers need to feel safe from the second they step foot into a car to the moment they reach their destination. Safety is the number one priority consumers look at when purchasing a car. Our company wants to give you that additional barrier that will allow drivers to have peace of mind. Our company will make sure that your passengers whether they are family or friends to obtain simple peace of mind.

Approach

D.A.V.E is used by placing the sensor band on your head and clipping the probe to your ear. The associated Arduino can be placed nearby, recommended to be clipped to the sun visor, in a safe location where the LED is visible and the speaker can be heard.

D.A.V.E. alerts the user through auditory ‘beeps’, a flashing LED light and vibration on the headband. By having multiple ways to alert the user, if one should fail, redundant alerts should continue to function until the unit is repaired or replaced. These functions will activate when the alertness level read into the Arduino is below the safe threshold and the alerts will continue to function until alertness is returned to safe levels or the unit is deactivated.

Situations where the user is undergoing long driving whether it is due to work, vacation or regular errands are instances where D.A.V.E can be utilized. D.A.V.E will allow the user peace of mind as it will improve their everyday driving safety.

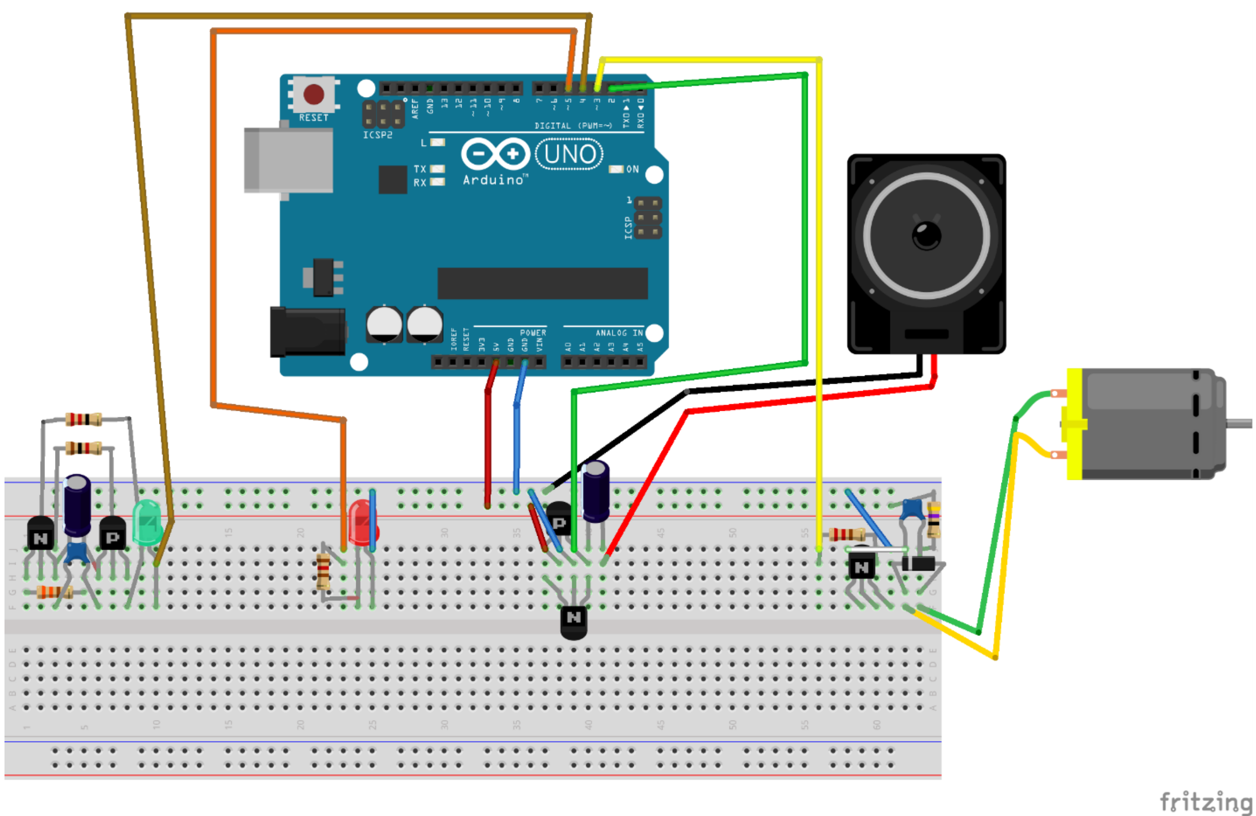
Benefits.

D.A.V.E gives the consumer a sense of security when driving to work, vacation or any ordinary errand. It will work to protect not only your life but the lives of Our product is very economical for the everyday consumer looking to feel safer when they step foot into any type of vehicle. Our product is applicable to any vehicle and driving experience. With D.A.V.E we will be able to target motorcyclists as well as boaters and pilots. Our product measures the actual brain waves as opposed to the facial features that our competitors monitor, in theory this will provide more accurate readings and less errors.

Competition

In today's world there are already successful products in the marketplace that aid the driver in similar ways. Major companies include Ford, Lexus, Mercedes-Benz, Volvo, Volkswagen, Vigo, and Anti Sleep Pilot. Judging from the wide array of well-known companies implementing the idea for driver assistance programs we can conclude that there is demand for driver assistance products. However, we can see that there will be plenty of competition. We are confident that we will set ourselves apart from the competition and succeed in our endeavor.

I. High Level System Architecture



The breadboard is split into four sections in addition to the Mindflex headset. The furthest to the left is a LED flasher circuit to make the green LED turn on and off through hardware means whenever the LED pin is set to high. This allows the LED to flash without having to turn the pin on and off with software. The next circuit to the left is a signal quality LED. This is to alert the user if the signal quality is low and that the system might have errors while responding to alertness. The center right circuit is a speaker amplifier circuit. This increases the output amperage to the speaker in order to drive it at a volume that is audible in a noisier environment. The circuit to the far right is a motor driver circuit. This is to provide appropriate amperage to the vibration motor used to alert the user through a tactile feedback.

II. SOFTWARE DESIGN

In this section explain how your program code is implemented to meet your system design goals. If there are a number of software modules that you implemented or utilized from other sources, explain their role and how you integrated them to achieve your main goal.

The software is designed to trigger a flashing LED, a motor, and a speaker to play a melody when attention drops below a preset sensitivity level. The software will also turn on a signal quality LED if the quality is below a preset threshold.

```
#include <Brain.h>
#include "pitches.h"

// Set up the brain parser, pass it the hardware serial object you want to listen on.
Brain brain(Serial);

//set the indicator outputs
```

```
int LED = 2;

int speaker = 3;

int motor = 4;

int connLED = 5;


//sensitivity

int sens = 20;


//set the speaker melody

int melody[] = {NOTE_C4, NOTE_G3,NOTE_G3, NOTE_A3, NOTE_G3,0, NOTE_B3,
NOTE_C4};


// note durations: 4 = quarter note, 8 = eighth note, etc.:

int noteDurations[] = {

  4, 8, 8, 4,4,4,4,4 };


void setup() {

  // Start the hardware serial.

  Serial.begin(9600);


//set LED output pins to output

    pinMode(LED,OUTPUT);

}
```

```
void loop() {
   // Expect packets about once per second.
   if (brain.update()) {

          uint8_t readIn = brain.readAttention();

        //read in the attention level

        Serial.println(readIn);

        //reset LED values

        digitalWrite(LED,LOW);
        digitalWrite(speaker,LOW);
        digitalWrite(motor,LOW);
        digitalWrite(connLED,LOW);

        //light up LEDs based on attention level
        if(brain.readSignalQuality()<50)
        {
          digitalWrite(connLED,HIGH);
        }
        if(readIn <sens)
        {
```

```
        digitalWrite(LED,HIGH);
        digitalWrite(motor,HIGH);
        // iterate over the notes of the melody:
        for (int thisNote = 0; thisNote < 8; thisNote++) {

        // to calculate the note duration, take one second
        // divided by the note type.
        //e.g. quarter note = 1000 / 4, eighth note = 1000/8, etc.
        int noteDuration = 1000/noteDurations[thisNote];
        tone(speaker, melody[thisNote],noteDuration);

        // to distinguish the notes, set a minimum time between them.
        // the note's duration + 30% seems to work well:
        int pauseBetweenNotes = noteDuration * 1.30;
        delay(pauseBetweenNotes);
        // stop the tone playing:
        noTone(speaker);
        }
       }


  }
}
```

III. Evaluation

Our project proposal called for our team to create a peripheral that would enable a "tri-alert system" of methods that would alert the driver if they were to approaching a state of drowsiness. We were able to make the system functional, by measuring attention levels that will set off a series of trigger alerts if they fall below our threshold, but it is not quite as accurate as we hoped it would be. This is because of time constraints that prevented us from being able to create an algorithm to decipher the data output from the mindflex headset as in depth as planned. Also other design concepts were unable to be realized because of lack of time. We were unable to implement Bluetooth technology due to time constraints and testing issues.

Our system functions, but can be very finicky. It will trigger when your attention falls below the threshold, and it will shut off when your attention rises, however because it is only tracking a single value, it can trigger at times when you are actually fully awake.

At this point in time the competition has much better performance than our product. Although their systems are only reactive, while ours is preventative, our product is not developed enough yet to actually be effective. Our product is much cheaper though. We estimate that we would be able to sell our system at about $100 per unit and make a decent profit, whereas our closest competitor sells their product for $250. In concept, our product is more flexible as it can be applied to any vehicle and would have more available features, but at this time in development the competition outweighs us in those fields.

IV. Conclusion

During the creation of D.A.V.E. our team encountered several challenges, the largest of which, would be being unable to decipher the data from the mindflex headset in a meaningful way. The numbers that are output for the different types of brain waves from the headset have no units, and are therefore only useful in comparison to themselves. We worked to find a way to convert these unit-less numbers into different values that could be used to determine awareness effectively. However, we were unable to find a way. We also had complications with the code that triggered the “tri-alert system”. We implemented a 3 sample filter to help reduce the amount of error in triggering. It was discovered that having a bad signal will throw off all of the data and typically trigger the system, so we created a bad signal indicator so that if it was sending alerts when it shouldn’t you would see that it was because of bad signal. The indicator would light up an LED to tell the user that there was a poor connection reading of 50 or greater. For future improvements, we would like to develop a better algorithm for calculating the triggers for the system as well as a sleeker appearance and design, including Bluetooth technology.

References

“Facts and Stats”. Drowsydriving.org. National Sleep Foundation, 2014. Web. 12 May 2014.

“ThinkGear Serial Stream 3DK”. Neurosky.com. NeuroSky, 6 June 2014. Web. 27 May 2014.