# EEL 4914 Electrical Engineering Design
# (Senior Design)

# Final Project Design Report

21 April 2008

# Project Title: LiveDrive Display

# Team Name: Team Road Rage

**Team Members:**

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**Project Abstract:**

This project will result in a system through which the driver of a vehicle can display a desired message to the driver of another vehicle. The message will be input using a keyboard that is easily accessible to the driver, and then displayed locally on a small LCD screen where the user can check the message for accuracy. The message will then be transmitted wirelessly to a second module located either in the front or rear of the vehicle. This second module will decode the message and display it on an LED-based display that is visible and legible to the driver of another vehicle. Technical challenges include interfacing the input device with the local processor, transmitting the data wirelessly, and then creating a custom display that will be visible to another driver at short range in nearly all weather conditions.

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## Project Objectives:

This system will be used by drivers of all sorts, including commercial vehicles and the everyday driver. For instance, the system could be utilized by the driver of a tractor-trailer when performing turns or backing up. Another application would be highway driving, asking permission to pass another vehicle, or for a driver to turn off their bright lights at night. While there are currently display systems on the market, they are typically pre-programmed for certain purposes, such as advertising. This system will be the only fully personal system that is used in on-the-go applications. Its key features include:

- Custom Made LED-Matrix Display
- A mini-keyboard for easy user input
- A LCD to verify message before transmission, with the option for the user to change or cancel the message
- Wireless Transmission
- Battery powered, portable system

## Technical Objectives:

The technical specifications of the system are given as follows, in order of least concern. Power consumption is not a primary concern for this system, because the entire system will run on 12V DC as provided by the vehicle battery, which is continuously charged by the alternator.

Transmitting the data wirelessly is also not a large concern due to the very short range needed and the minimal data transmission required. Due to these requirements being quite lax, the wireless transmission will probably be implemented using a simple radio frequency transmitter/receiver pair. The largest concern of the wireless transmission will be interference from other radio-frequency signals causing corruption of the transmitted data.

The primary concern of the input module will be usability and safety. The primary concern of the display module will be visibility and size (number of characters able to be displayed.) The size of the unit will be a balance of visibility and the size constraints placed on the unit by the size of the vehicle. This display unit will be built using an array of LED characters and controlled by a CPLD.

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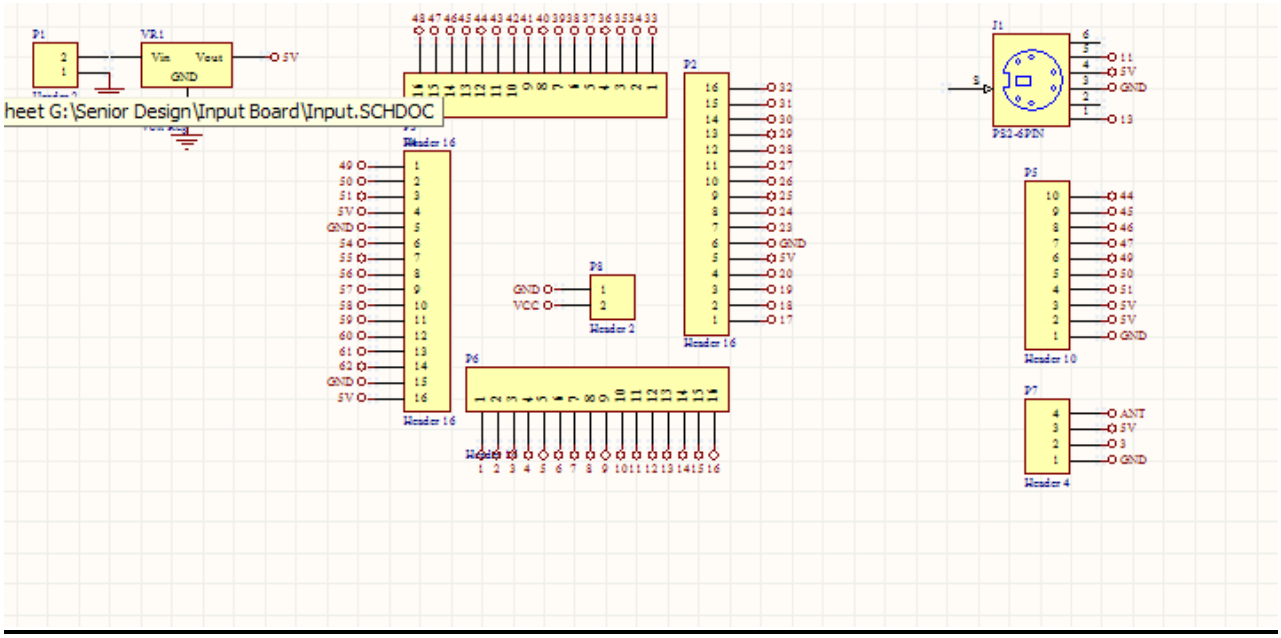
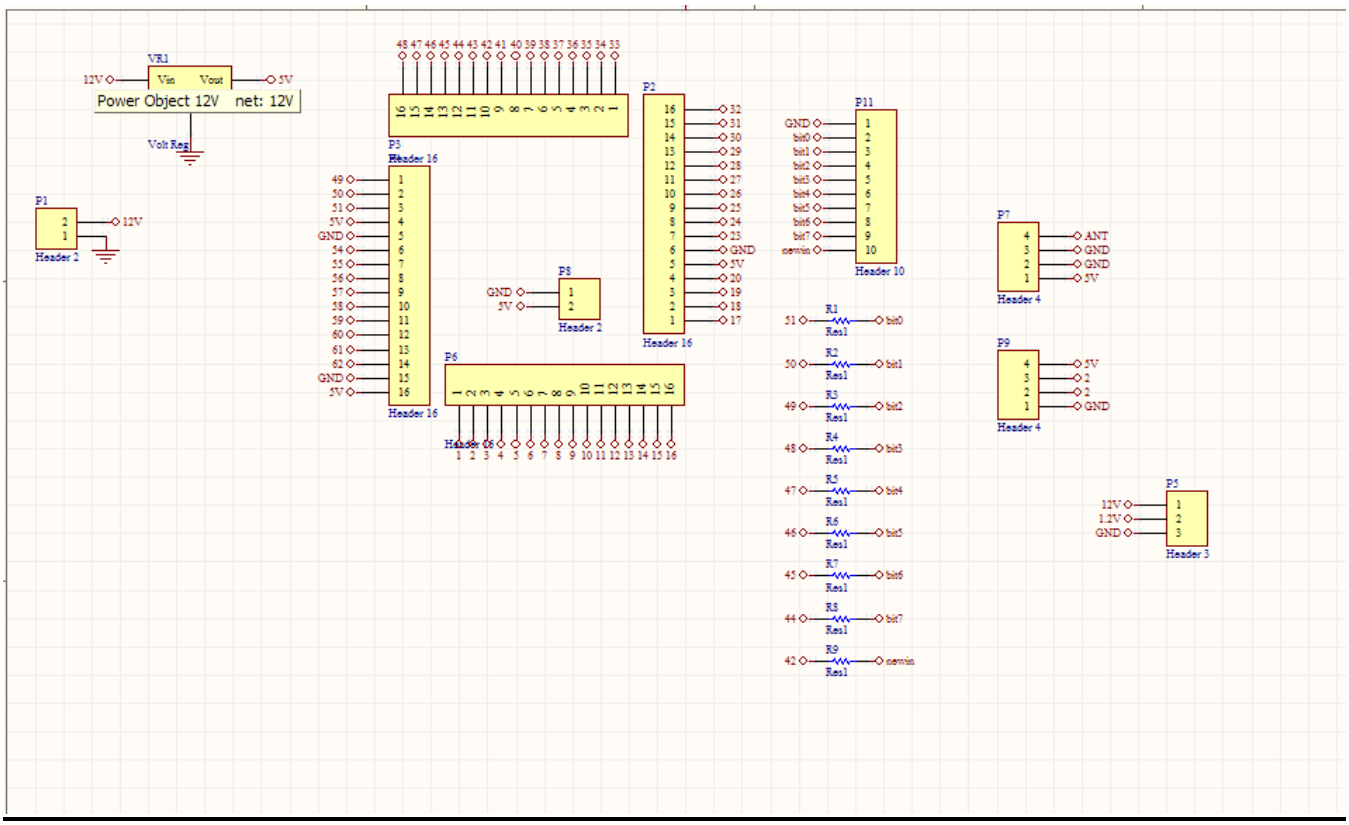
## Project Architecture:



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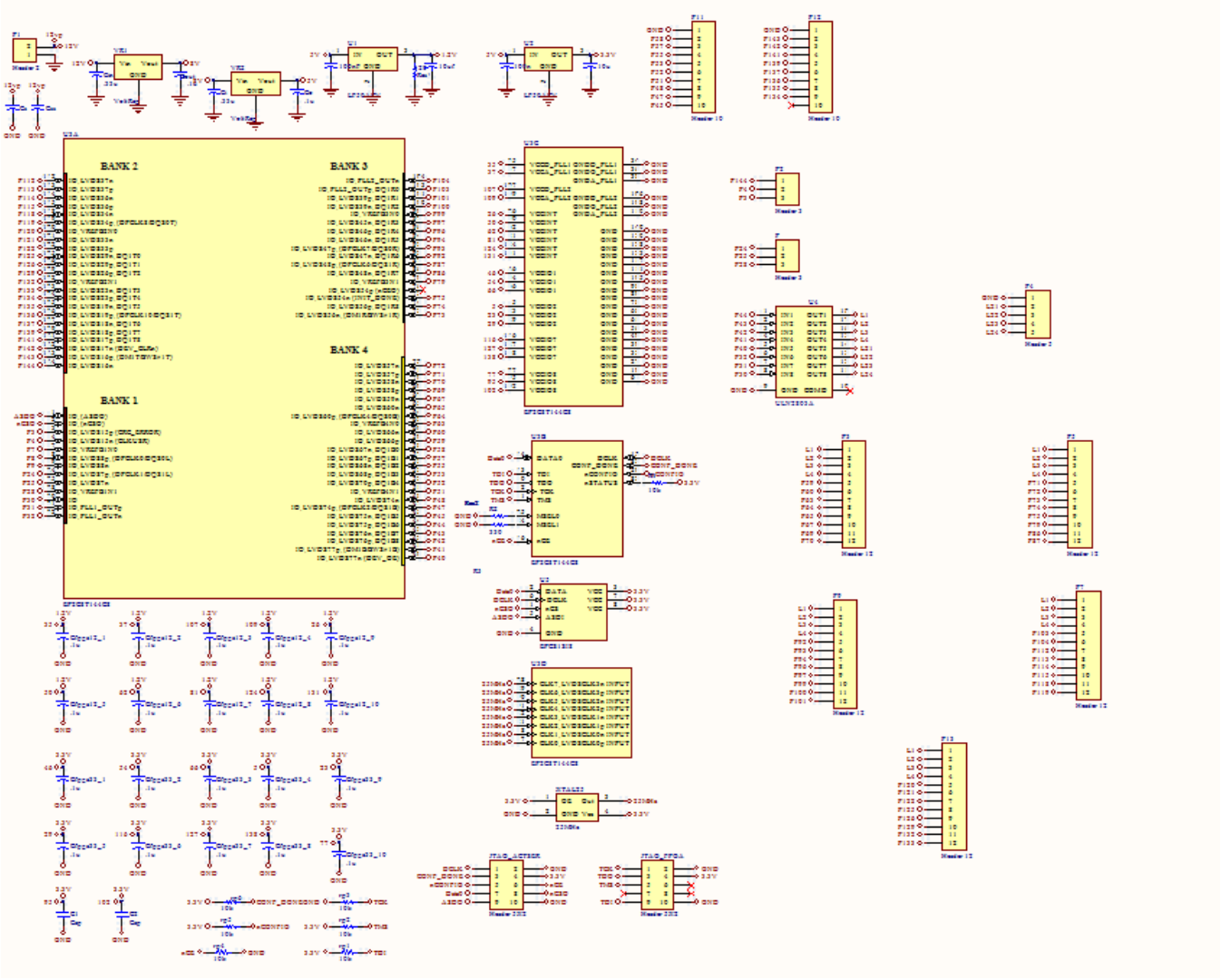

## Concept Selection:

Tables 1 through 4 summarize the concept selection for each major unit of the system, as explained below.

For the processor selection, programming difficulty and compatibility with the project objectives were the main factors. Since the Atmel has necessary built-in functions for our project, such as UARTs, program functions, and interfaces to the USB and CPLD; it proved to be the superior option. Table is the concept table for this component.

| Controller | Compatibility | Program Difficulty | Choice |
|---|---|---|---|
| Atmel | High | Medium | X |
| Pic | Low | Low | |
| MSP430 | Medium | High | |

**Table 1**

Since only a short range of transmission is needed for the wireless system, the RF link from "sparkfun" is the appropriate choice.

| Wireless | Range | Usability | Choice |
|---|---|---|---|
| Xbee Pro | High | Low | |
| RF Link 4800bps | Low | Medium | X |
| Nordic | High | High | |

**Table 2**

The cost, complexity, and user friendliness of the input system were the deciding factors in selecting the input system. The voice recognition's high complexity and cost eliminated it as a choice. Since the keyboard is easy to use and is relatively cheap and simple to integrate into our system, it will be used for the input data.

| Input System | Cost | Complexity | User Friendly | Choice |
|---|---|---|---|---|
| Touchscreen | Medium | Medium | Medium | |
| Voice Recognition | High | High | High | |
| Keyboard | Low | Medium | Medium-High | X |

**Table 3**

The main issue with the output system is the visibility. Obviously, surrounding drivers should easily be able to read the message outputted to the display. The "Headsup" Display system has issues when it is bright outside. Instead, a custom made 20 LED-Matrix will be built. See Figure 2 for a conceptual diagram for this system. Although the display will be harder to design and build, its superior visibility and lower cost will enhance our product marketability.

| Output System | Visibility | Cost | Usability | Choice |
|---|---|---|---|---|
| 20 LED-Matrix Display | High | Medium | Medium-High | X |
| "Headsup" Display | Medium-Low | High | Medium | |

**Table 4**

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**Diagrams:**

Figure 1 is the functional diagram of the overall system, showing how the components will be grouped together to achieve the project objectives.

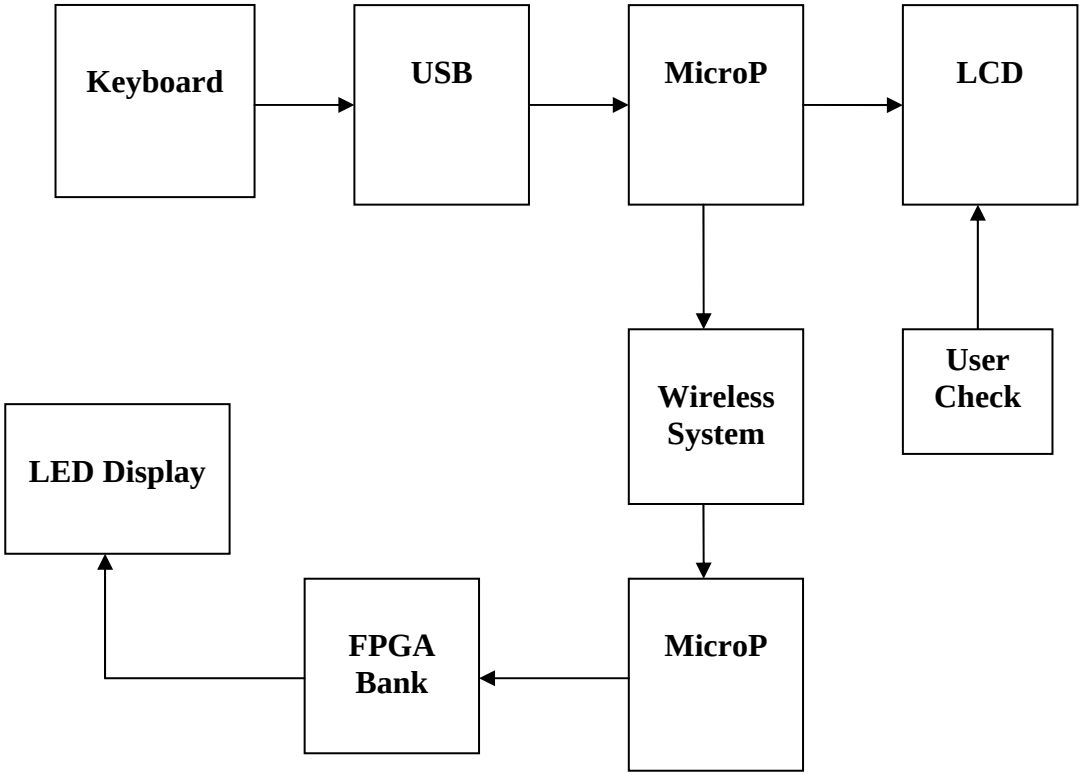


**Figure 1**

Figure 2 is a conceptual diagram of the LED display system.


The marquee-style sign will be constructed with 20- LED matrices as shown above. The matrices will be controlled using a CPLD.

**Figure 2**

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## Member Responsibilites:

Table 5 summarizes the responsibilities of each member and the team.

| Hussam | Kenneth | Team |
|---|---|---|
| Keyboard to Processor Testing | Output System Programming | Debugging |
| Input LCD User Check | LED Display | Board Design |
| Input System Programming | CPLD | Soldering |
| Wireless Transmission | | Miscellaneous Issues |

**Table 5**

## Bill of Materials:

*Display module*:

- 20- LED Matrix displays @ $7/ea -- $140
- 1- Atmega128 processor @ $35/ea -- $35
- 4- Cyclone II FPGAs @ $12/ea -- $48
- 1- Wireless receiver @ $7/ea (1/2 transmitter/receiver pair @ $13) -- $7
- Miscellaneous parts -- $100

*Input module*:

- 1- miniKeyboard @ ~$25/ea -- $25
- 1- 2X20 Character LCD @ $3/ea. -- $3
- 1- Atmega128 processor @ $35/ea -- $35
- 1- Wireless transmitter @ $6/ea (1/2 transmitter/receiver pair @ $13) -- $6
- Miscellaneous parts -- $4

Total Cost for System: ~$400

## Gantt Chart:

Table 6 further details the task organization. The Gantt Chart in Figure 3 shows the weekly progress scheduled to complete the project. Sufficient time was allocated for the LED display construction, system programming, and board construction and debugging.

| Task Name | | Planned | Extension | Down time | |
|---|---|---|---|---|---|
| Introduction (team) | 0 | 1 | 2 | 0 | 3 |
| Research/Parts Selection (team) | 0 | 2 | 1 | 0 | 4 |
| Input to Processor Testing (Ken) | 2 | 2 | 0 | 0 | 4 |
| LED Display (Hussam) | 3 | 2 | 2 | 0 | 7 |
| Input LCD User Check (Ken) | 4 | 1 | 1 | 0 | 6 |
| Input System Programming (Ken) | 7 | 2 | 2 | 0 | 11 |
| Output System Programming (Hussam) | 8 | 2 | 3 | 0 | 13 |
| Wireless Transmission (Ken) | 10 | 1 | 1 | 0 | 12 |
| Board Design and Population | 12 | 2 | 0 | 0 | 15 |
| Testing and Demo | 13 | 2 | 1 | 0 | 16 |

**Table 6**

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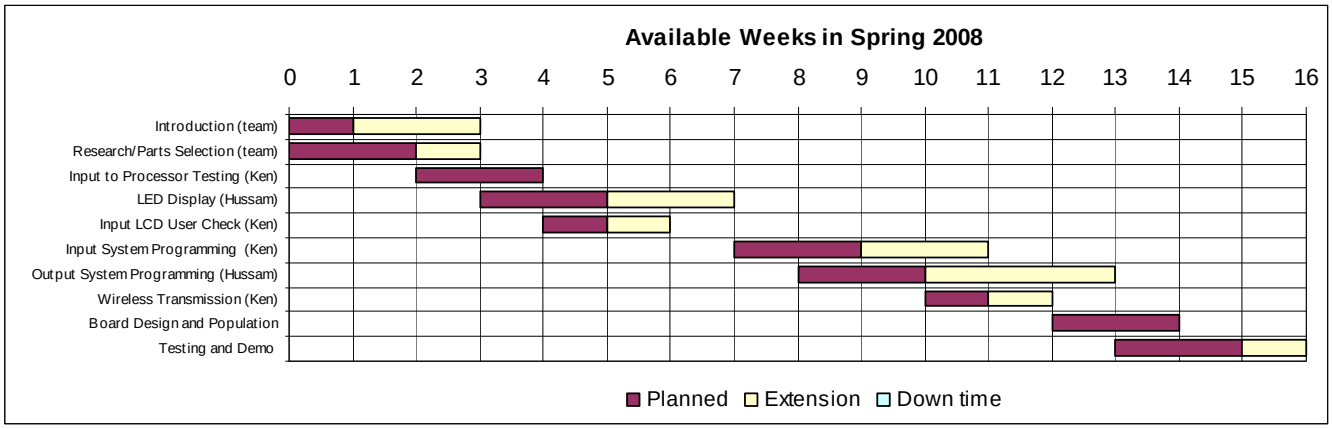


**Figure 3**

## References:

1.) http://www.sparkfun.com/
2.) http://www.barefeetshop.com/