University of Connecticut

Electrical and Computer Engineering

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Remote Controlled Scoreboard

Final Report

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Introduction:

The objective of our senior design project is to design a remote controlled scoreboard that is easy to use, portable, and cost efficient. This project is sponsored by the University of Connecticut Electrical and Computer Engineering Department and is to be completed by May 2007.

Background:

A scoreboard is a device that allows spectators and players to be able to know the score at every point in the game. This is critical to competition as teams usually strategize their game play based on key factors related to the information displayed on the scoreboard such as the time remaining in the game, which team is in the lead, and by how many points? In order for this information to be current and easily updateable it is best that the scoreboard be remote controlled.

The target audience for our project is a small town; therefore we are creating a portable scoreboard that can easily be used for multiple sporting events.

Proposed Solution:

To create a fully functional scoreboard there are many technical issues; they are the layout of the scoreboard, the method of communicating the data and the way in which that data is then displayed. These issues coupled with other design factors such as visibility and power dissipation will be addressed in the following section.

Layout:

The layout of the scoreboard (figure 1) was chosen because the parameters displayed (home score, away score, period and time) can be used in most major sports such as football, soccer and baseball.   In addition these parameters were chosen because

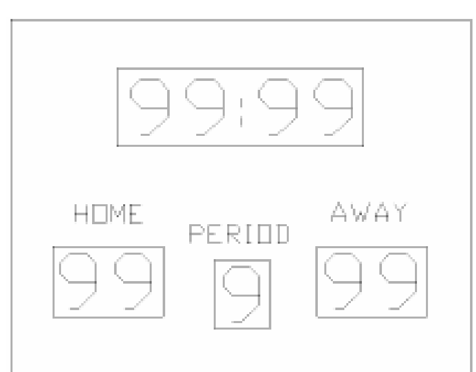
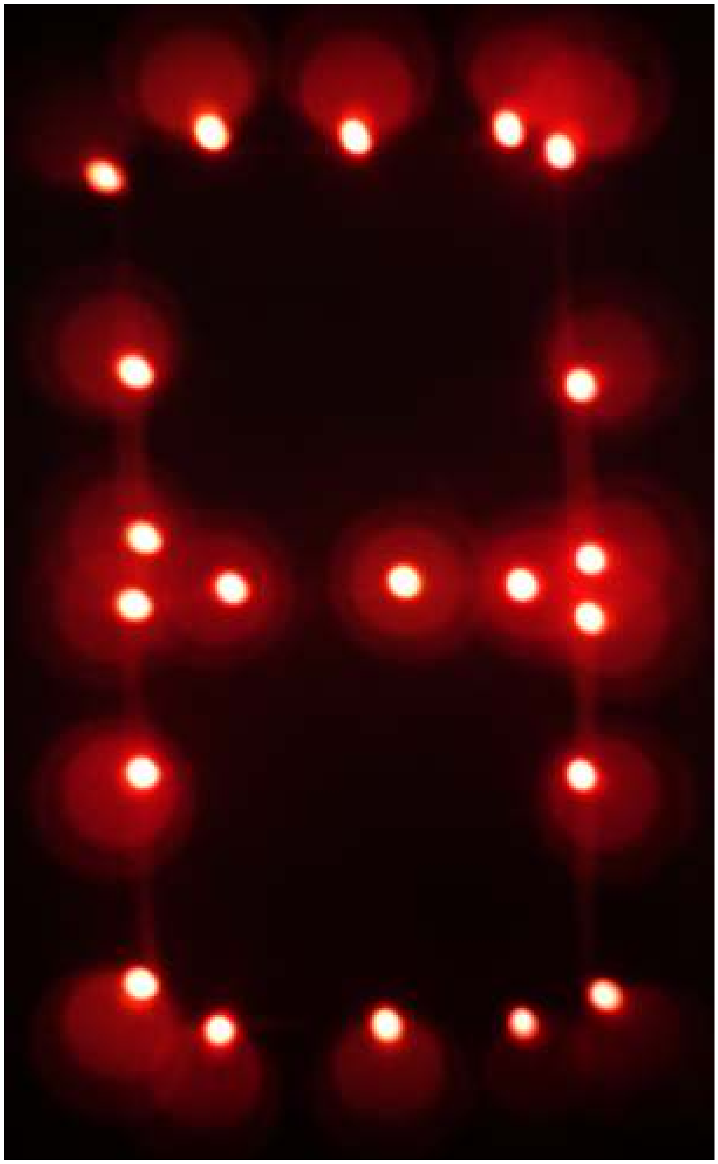


Figure 1

we want to keep the size of the scoreboard reasonable so that it can be portable yet still be large enough to be visible from a long distance. Therefore it is necessary to have adequate spacing between the displays so that the digits do not blend together making the scoreboard difficult to see.

In order to display the score and time to fans and players, we need a scoreboard display that will be large enough, bright enough, and display the numbers in a color that is visible in most settings of ambient light. The 7 segment display is constructed out of 21 high intensity red LEDs, using 3 LEDs per segment. The LEDs used in demonstration were actually lower power, approximately 60mW, than what will be used in the final project but were still able to be seen clearly at 100 feet. The dimension of each 7 segment display was constructed to have a 6 inch height and 3 inch width but one problem we ran into as we walked farther away from the lit display was that distinguishing between each segment began to disappear and the segments would blend together, making determination of different numbers harder. One way we plan to correct this is to use a light filter which will blend the LEDs of each segment together. Red LEDs will also be used to aid in the visibility of each segment. The visible light spectrum describes different colors as distinct wavelengths ranging from 380 nanometers to 750 nanometers, with red falling in the 700 nm range and infrared light in the 750 nm to 1mm range. The human eye has rods and cones that see light, dark, and color. Red, having the largest range of visible light, is seen the best by the eye because of its reception by cones in the retina. This is also why red is used in applications where high visibility is absolutely crucial such as stop and brake lights, air traffic control, and warning signs. In order to increase visibility outside of color and size, we will use a black color contrast around the LED segments. This is an easy and inexpensive way to increase visibility for our scoreboard displays.



Infrared communication

The data will be sent from a remote control via infrared and received by an IR receiver, which then sends the data to the microcontroller for decoding. The corresponding data is then displayed on the scoreboard. The first phase of our design project is to create a scoreboard that is able to communicate via the remote for a small distance of approximately ~30ft. Then once we complete this part of the project we hope to amplify the signal and have it be able to communicate at approximately 300ft. Figure 2, shown below demonstrates how the final design will be implemented.

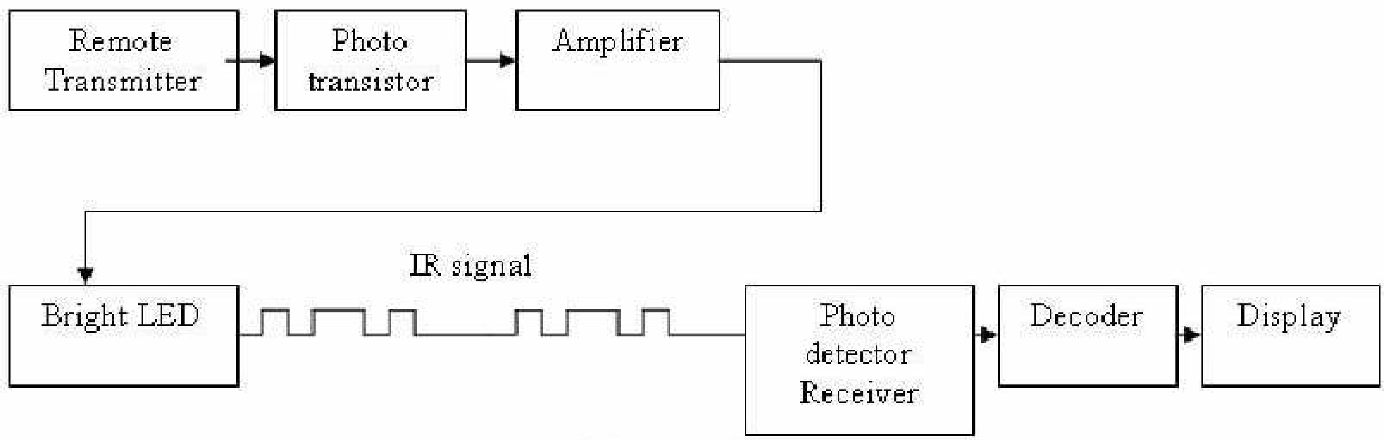


Figure 2

The way in which we choose to communicate the data was using infrared. By using an infrared signal we will be able to use a wireless system. One advantage of infrared is that you never have to worry about interference from other wireless systems. Infrared is a line of sight based system, so using the wireless system will be as easy as a point and click.

In order to send a signal we have decided to use the TEAC RC-505 remote control. In order to receive the signal sent by the remote our group has opted to use the Sharp GP1UE281XK Series IR Receiver. The remote control operates on basis of transmission of short (T<100 ms) burst of ~ 38 kHz infrared pulse train. In order to figure out the signal we decoded it. In order to accomplish this task we used a transmitter, receiver, power supply, and digital oscilloscope. We setup the system so that when a signal was sent from the remote transmitter the IR receiver would read the signal. The digital oscilloscope was setup to capture the signal as an image so that we could decode it.

Basically what was seen on the digital oscilloscope were a series of long and shorts in the form of a rectangular wave function. This can be seen below.

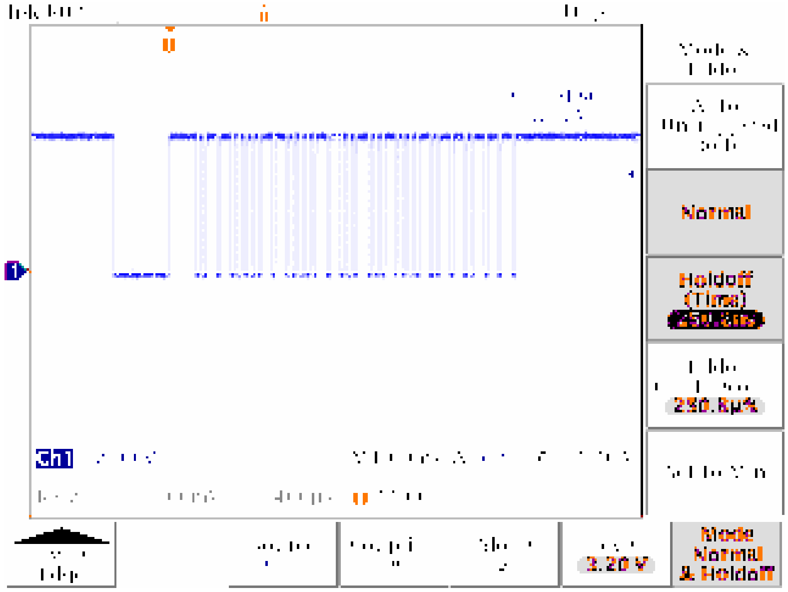


Figure 1. Signal from TEAC RC-505 Remote

The signal is comprised of logic 1's and 0's. The short pulse is logic '0' and long pulse is logic '1'. Measuring the pulses we found that the short is for 0.520 ms and the long is for 1.62 ms. The code is a total of 4 bytes. The first two bytes display the address of the button pressed and the third and fourth bytes are the complement of each other and make up control code. (Professor Martin Fox)

We decoded buttons 0-9 and discs 1-5 as well as disc skip. The way in which the 0-9 buttons can be implemented is that will use the scoreboard to insert numerical values. We would enter each value using the 0-9 keys. For example, if we would like to set a time of 12:00 we would simply press "1", "2", "0", and "0". The disc skip buttons will be used to change from section to section on the scoreboard. An example of this would be changing from home to away or from period to time. This will help make the user interface easy to use.

The actually setup of the decoding process was fairly simple. The IR receiver had three pins, Vcc, Vo, and GND. We connected positive 5V from the power supply to Vcc. We connected the probe of the digital oscilloscope to the Vo pin. The ground on the probe as well as the negative (with respect to ground) and ground on the power supply were connected to the GND pin on the IR receiver. Our setup can be seen in figure 2.

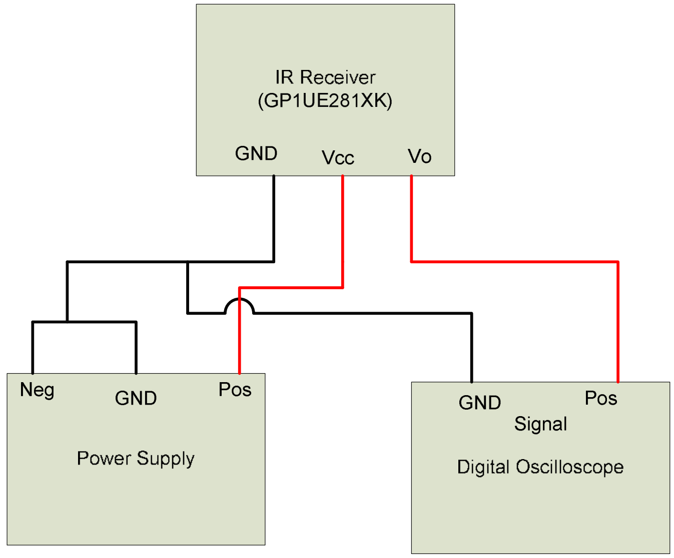


Figure 2. Block schematic of our test setup for decoding the transmitter.

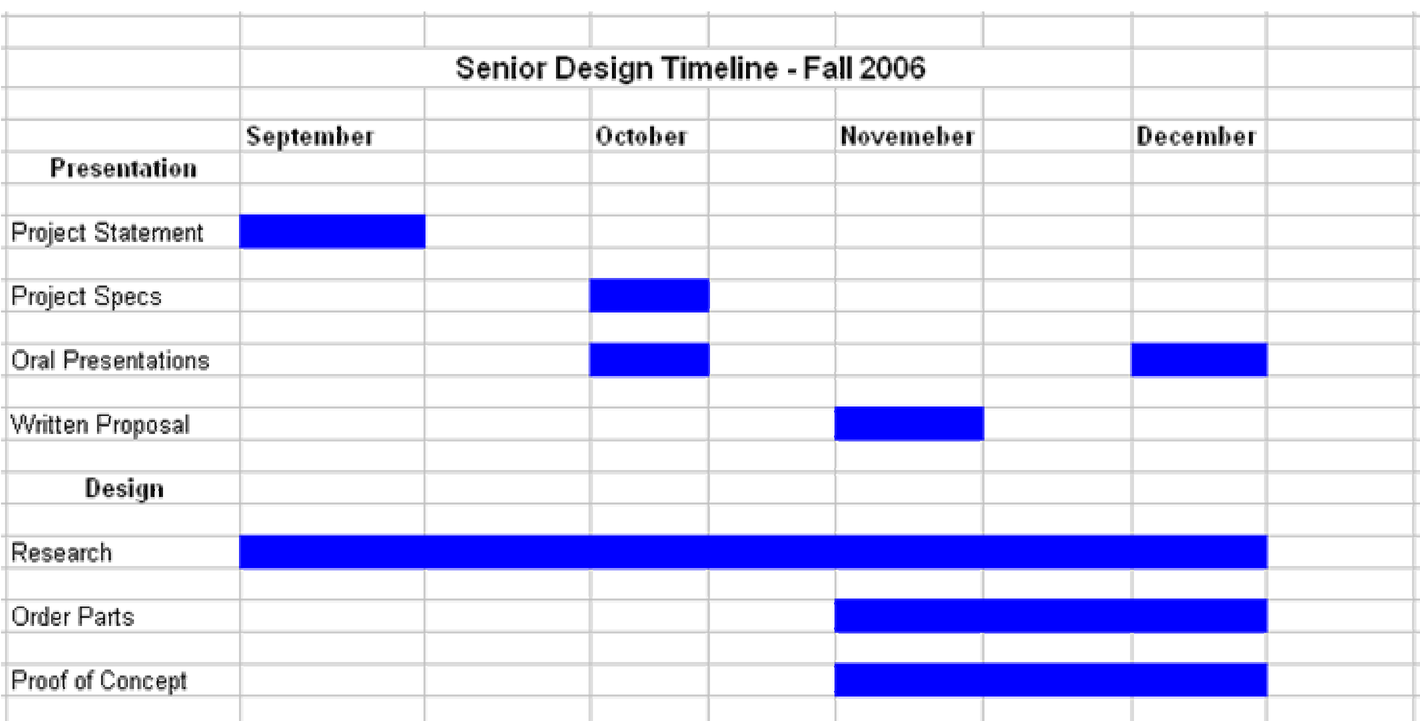
Figure 3. Our test setup for decoding the transmitter.

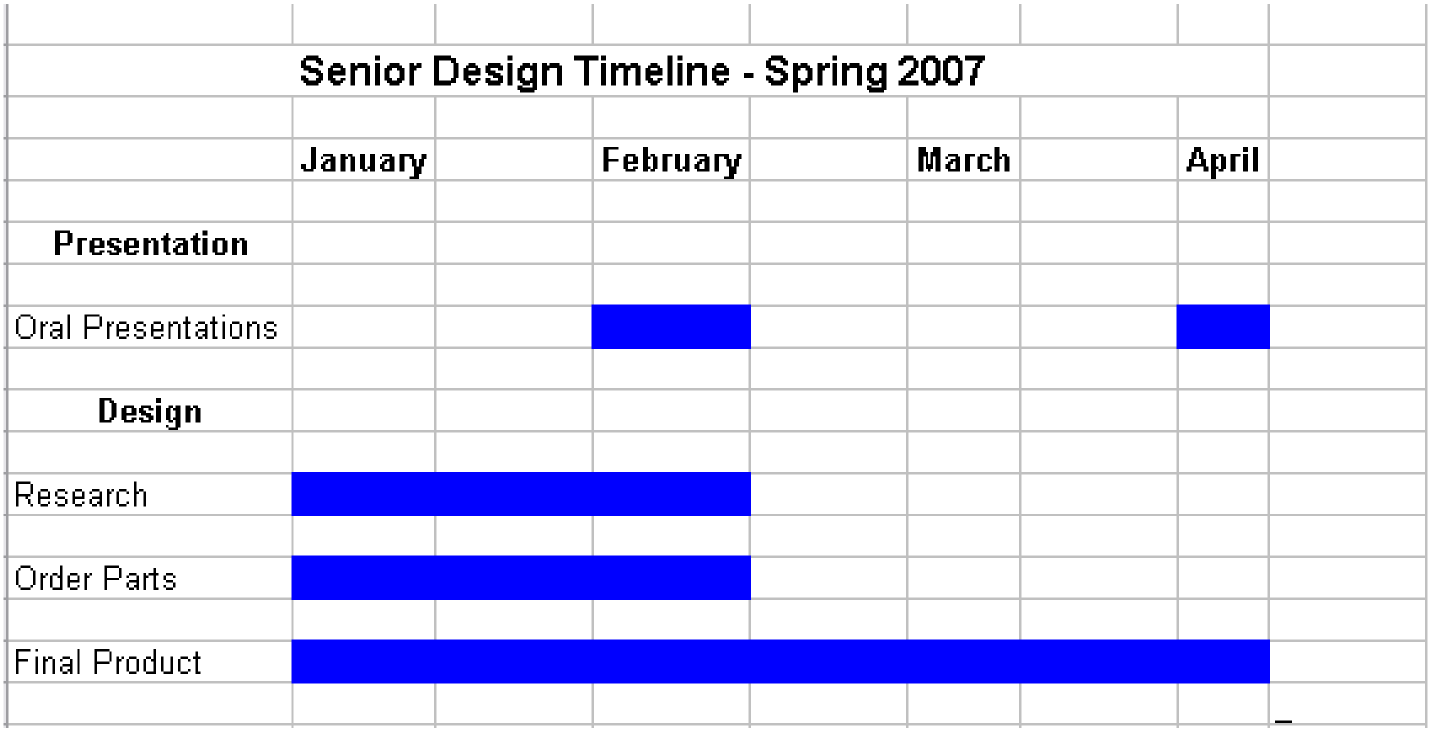
Our power supply to power the actually scoreboard is still under question. Right now we are looking into a 12V lead acid battery. The battery will be officially chosen after our power budget is finalized. We are bases our power budget mainly on the display, since the LEDs will consume the most power.

The microcontroller that will be used will be an 8 bit PIC manufactured by Microchip. Eight bits is large enough to store and run all encoding/decoding and addressing for the scoreboard. The specific chip number is PIC16F874 and will be programmed so that each short and long IR pulse will be decoded into a different function and apply this function to the scoreboard accordingly. Doing this efficiently and affectively will probably be the hardest task in completing a working scoreboard as this is a new concept and will require some previous knowledge of programming and microcontrollers.

Timeline

Below is a representation of our first semester timeline and our anticipated second semester timeline. We feel that during our first semester, the deadlines that were required to be met were indeed met and that our progress on a proof of concept was met to the best of our ability. As far as winter break and next semester goes, we need to begin ordering parts and start working on a physical representation of our scoreboard as soon as possible. If we stay as close as possible to following our anticipated guideline, we will successfully accomplish our ultimate task, a working scoreboard, along with its requirements.





Budget

Our projected budget is still somewhat inaccurate as we haven't begun to order products and begin any sort of printed circuit board design. The first phase of ordering such parts will begin starting next semester and a preliminary list of what needs to be ordered to start any sort of manufacturing will be completed by the end of break. The anticipated budget is show below.

Budget		
Device	Quantity	Price
Microcontrollers	2	$20
Red LEDs	250	$125
Remote	1	$15
Battery	1	$250
Battery Recharger	1	$0 (donation)

Circuit Items	N/A		$150
Raw Materials to Build Scoreboard	N/A		$150
Total			**$710**

Conclusions

Our group feels that we our on schedule to complete the senior design project on time. The main problems have been ironed out, and the new obstacles that we face we are confident that we will overcome. Research will always play a vital role up until the project is complete and our hard work and dedication will prove to payoff in the end.